AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

APRIL, 1958

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Precision Metal Molding

PMM

INCLUDING DIE CASTINGS MAGAZINE

DIE CASTINGS

INVESTMENT CASTINGS

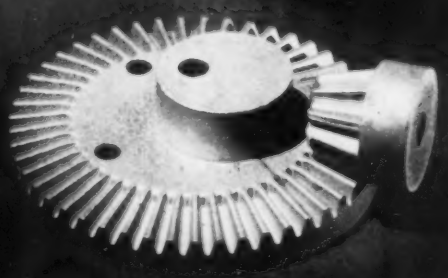
PERMANENT MOLD CASTINGS

PLASTER MOLD CASTINGS

POWDER METALLURGY

SHELL MOLD CASTINGS

7th Annual



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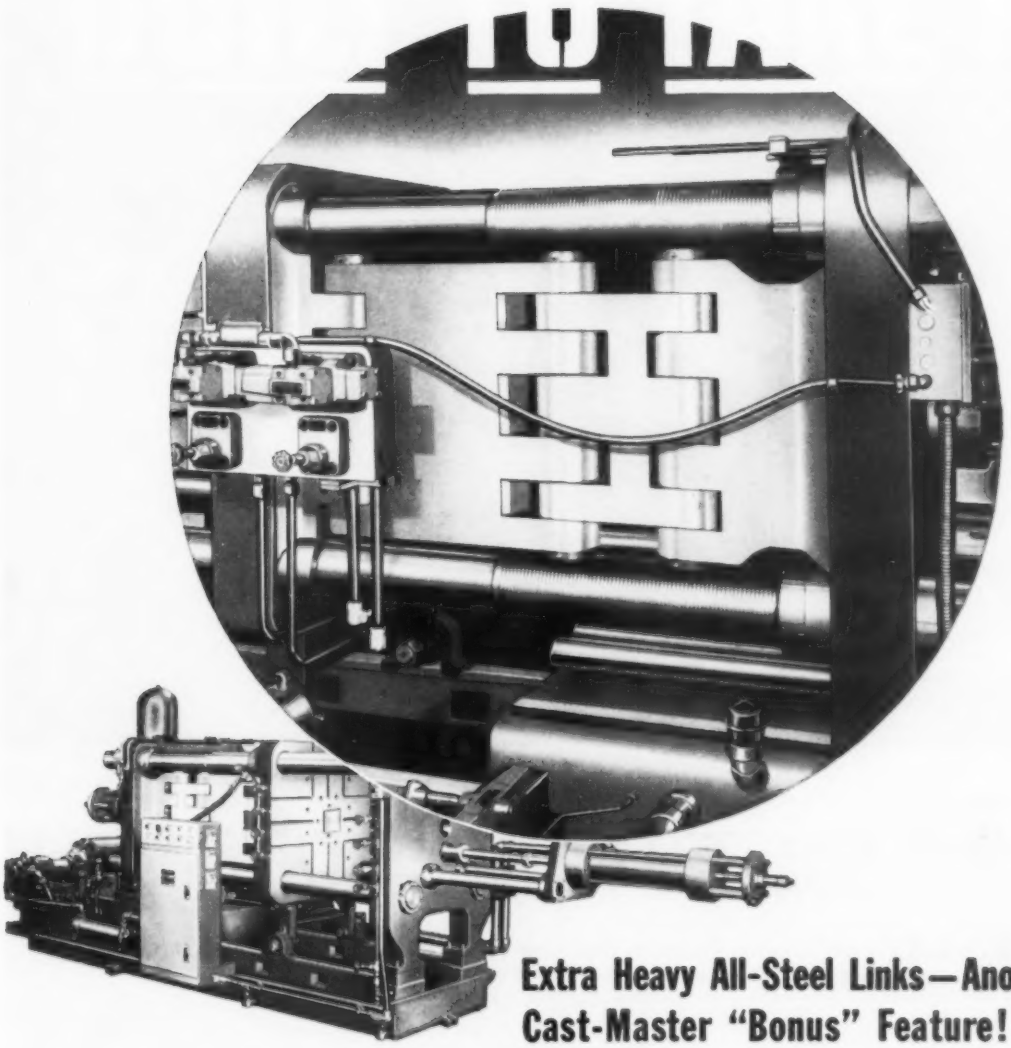

Extra Heavy All-Steel Links—Another Cast-Master "Bonus" Feature! . . .

The story of Cast-Master quality is a story of "bonus" features — like the link system shown here. Cast-Master links are super-rugged — all-steel — machined — with wide spread for positive lock-up, and multiple shear points to eliminate link pin breakage. Result? — more precision — lower maintenance costs for Cast-Master owners. To get the complete "bonus" story, send for the new Cast-Master catalog.

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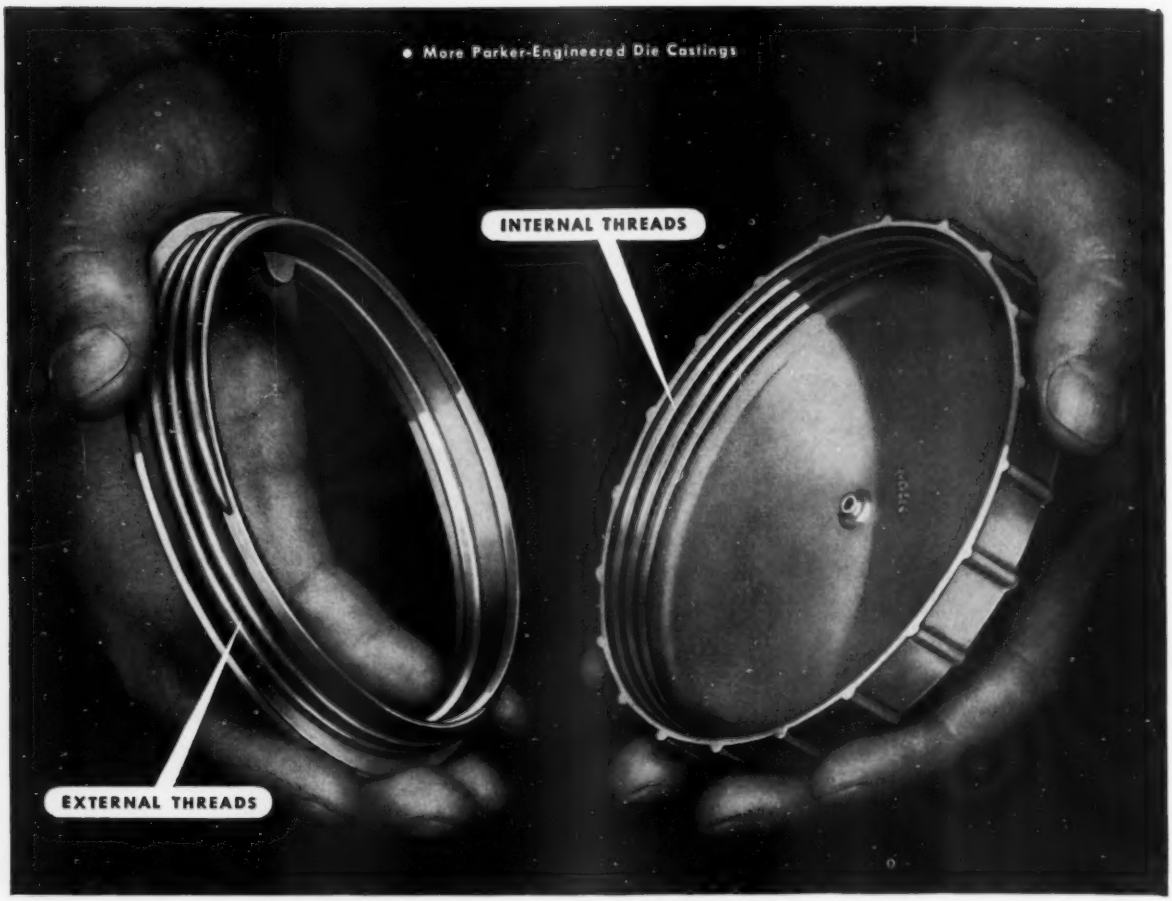

From ONE Die: TWO Parts... THREE Savings!

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These two mating parts, including the threads, are cast simultaneously in the same die. The result—three savings:

1—One die instead of two *saves die cost*

2—Casting two parts at one time in the same die *saves production time*

3—Precision casting of the perfectly mated threads with no parting line *saves machining cost*

Together, these three savings result in a substantially lower cost per piece. Just another example of the way Parker-engineered die castings save you money.

Parker has been a leader in die casting for over 50 years—an old hand with new ideas. This skill and experience can solve problems — and save money—on *your* component parts. Just call the nearest Parker sales engineer or write the factory direct.

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POWDERED METAL PARTS

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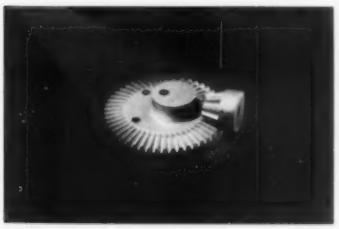
COVER



THE SEVENTH ANNUAL directory of the powder metallurgy industry is presented with this issue. As in previous directories, this one lists all of the custom fabricators of powdered metal parts, the suppliers of metal powders and the equipment builders. Every effort has been made to make this directory as complete and as useful as possible; it starts on page 65.

FEATURE ARTICLES

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This new technique in powder metallurgy is fully reported and properties of parts made of fibers are given.

27 **INVESTMENT CASTINGS IN THE H-35**
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28 **INVESTMENT CASTINGS FOR SPECIAL PARTS**
How two makers of aircraft parts have been able to cut costs through the use of investment castings.

30 **DESIGNING FOR ALUMINUM PERMANENT MOLD CASTINGS**
The second article of a series. This one gives some of the advantages and limitations of the permanent mold process.

33 **PRECISION PARTS EASE PILL-DISPENSER HEADACHES**
To insure low-cost manufacture and maintenance-free operation; this unit is made almost entirely of zinc die castings.

35 **USE DIE CAST INSTRUMENT COMPONENTS**
A stronger assembly, complete interchangeability of parts, better appearance and lower manufacturing costs result from a change to die cast parts.

37 **DIE CASTING LUBRICANTS, THEIR PURPOSE AND USE**
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41 **DESIGNING FROM THE INSIDE OUT**
By careful design, every part, including the case, can be made highly functional and, by die casting, made at the lowest cost.

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A description of a simplified, central vacuum system that can be adapted to any machine casting aluminum.

47 **DESIGN TIPS**
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FINISHING SECTION

51 **FINISHING DIE CASTINGS**
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54 **USE CHEMICAL MILLING TO MAKE TIGHT, CLOSE-TOLERANCE PARTS**
Applied for some time to sheet and wrought parts, chemical milling is now being applied to castings.

DIRECTORY SECTION

67 **NEW DEVELOPMENTS IN POWDER METALLURGY**
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71 **PRODUCT LISTING**
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produces a powerful but very compact soundcaster by using

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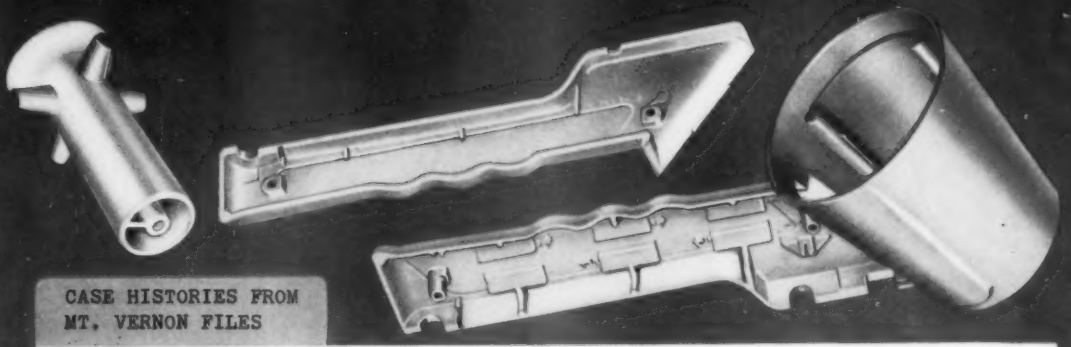

CASE HISTORIES FROM MT. VERNON FILES

In this model PP-2 Pistolgrip "Powrpage," University has embodied the most advanced features of any electric sound-casting system. Aim, press, talk—it projects clear, powerful sound in any direction. A mighty voice for such a compact, light weight unit, only 4½ pounds including batteries. The Pistolgrip with microphone built into the horn base permits ready, one hand use. 6 pencil batteries are all held in the slim handle which also contains the "Powrsaver" press-to-talk switches and—the entire unit is *weatherproof* throughout.

How was such compact design achieved . . . by resorting to die casting which gives thin, rigid sections of great strength.

How was weight brought down to 4½ pounds . . . by die casting three main parts in aluminum.

How was cost held down to lowest figures possible . . . by utilizing all the inherent advantages of die casting to make the intricate shapes economically. The two-casting handle houses microphone, driver unit and power supply and the tone arm combines an outer shell with four spacer arms and an inner sound director core into one unit.

How was it made so weatherproof . . . because die castings can be held to extremely tight tolerances.

You too can realize the many advantages of die casting by using the complete service available from Mt. Vernon's coordinated designing, die-making, casting and machining facilities all under one roof, which can supply die cast zinc and aluminum parts ready for use. Contact your nearest Mt. Vernon sales representative for action.

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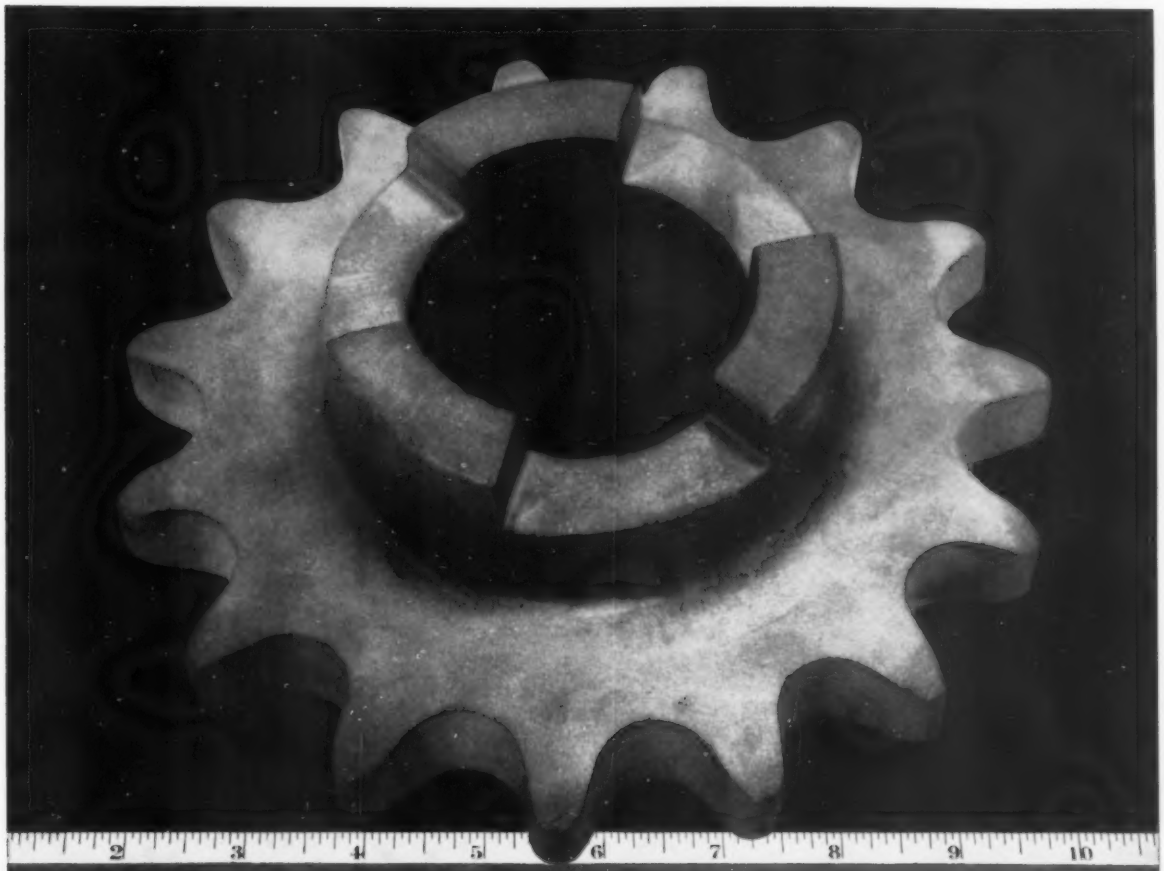

Actual photograph of a Cast Tooth Sprocket Gear in ASTM: A-148-53T Grade 90-60 Steel made in H-W Forsterite Grains shell mold by Fort Pitt Steel Division, Pittsburgh Steel Foundry Corporation.

SMOOTH CAST SURFACES result from resin-bonded shell molds of H-W FORSTERITE GRAINS

Forsterite grain is highly refractory magnesium silicate possessing physical properties which make it especially suited for resin-bonded shell molding. Its specific heat, thermal conductivity, high temperature stability and uniform thermal expansion —all contribute to its excellent performance.

As the result of the optimum chilling effect of forsterite grain, sufficient strength develops in the skin of the steel casting to resist outside gas pressure as well as inside ferrostatic pressure, and a smooth casting surface is assured.

H-W FORSTERITE GRAINS are supplied in controlled sizings best suited for securing the most satisfactory shell molded casting surfaces.

H-W FORSTERITE FLOUR is furnished for use as an additive to the H-W FORSTERITE GRAINS and resin mix to provide for the ultimate in surface smoothness, particularly of castings with heavy sections. Write for bulletin No. 6.

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They're intricate . . .

They're tight on tolerances . . .

They're subject to destructive service . . .

They're money-savers when they are Inco precision-cast!

In pairs, these tricky little parts form a carbon electrode holder for moving picture projectors.

The manufacturer specifies "D"* Nickel for the part. This metal provides high-strength and electrical conductivity . . . resists corrosion and spark erosion, even when temperatures climb to 750° F.

Looking for the most economical method of production, the manufacturer talked over precision investment casting with Inco. The part seemed a "natural": small . . . intricate . . . tight on tolerances.

They were right! Precision-cast by Inco, the part requires only *one* machining step . . . drilling a hole.

Here's how you can save: Whenever you have a high-melting-point metal part which is 6 inches x 5 inches or smaller, weighs under 3 lbs., required starting tolerances as close as plus or minus .005 inch per linear inch, and needs 5 or more fabrication steps, look into Inco precision casting. It often gives required precision with less machining.

Send us a sample or blueprint. Our Engineering Department will be glad to submit their recommendations and quotations on Inco precision investment castings.

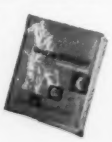
*Registered trademark

5 Advantages of Inco Precision Castings

- **Save up to 60% of production costs.**
- **Longer life with harder alloys.**
- **Little or no machining required.**
- **Wider design latitude.**
- **Higher alloys at lower cost.**

Get This Helpful Booklet

Trying to keep costs in line on some small part? Then write for the 16-page booklet, "Cast to Outlast." Illustrated with case histories that may suggest a practical answer to your problem.



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No matter what your requirements--

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DIE-CASTING TECHNIQUES provide the low-cost answer!

The great versatility of the die-casting process has been brought to its highest development by Dollin engineers, die-makers, foundrymen and Dollin specially-designed, automatic, high-speed equipment.

Dollin has helped to design and has produced thousands of shapes and sizes with the exact fidelity of design, close tolerance, weight, metal structure and surface finish to meet the requirements of each application.

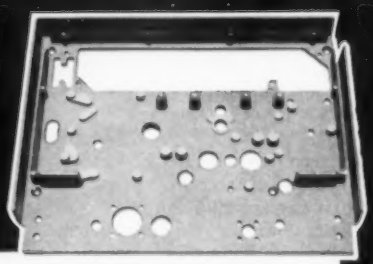
These bonuses go with every quotation from Dollin, at no extra cost. Send prints or samples of any parts for cost-cutting or product-improving suggestions.

LARGE PARTS

Aluminum castings made on large cold chamber type, high pressure machines. Zinc castings made on large plunger type machines.

SMALL PARTS

Zinc castings, 1000 per lb. to 3 per lb., accurately made on fully automatic machines. More design latitude, low tool costs, low piece prices.



INTRICATE DESIGNS

Dollin engineers and die-makers provide practical solutions to complex designs—open new possibilities for the use of die-castings.

EYE APPEAL

Sound, clean castings without surface imperfections permit low-cost buffed finish—provide better base for plating or organic finishing.

HIGH STRENGTH

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PMM CASTING ABOUT

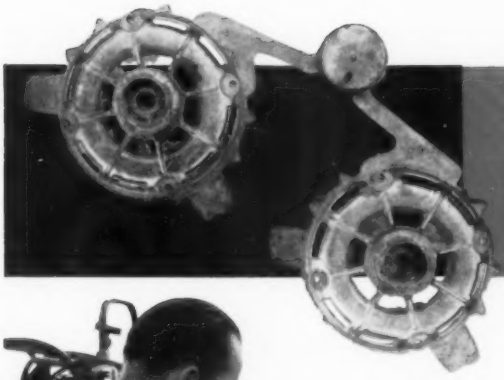
technical news of applications & processes involving precision metal moldings

PLENTY OF BORON for all of the anticipated needs of the free world is assured for the next 100 years. Out in the Mojave desert, 130 miles northeast of Los Angeles, the United States Borax & Chemical Corp. has opened a new $20,000,000 open pit mine and refinery. Boron is regarded as an important factor in high energy fuels and has more than 100 different industrial uses in the manufacture of such products as glass, ceramics, plastics, agricultural chemicals and many others. As a part of the recent dedication activities, a symbolic "final" load of ore was hauled out of the mine by the famous 20 mule team which transported borax ore from the company's Death Valley mines in the early days of California history. Today the "symbolic mule" has been replaced by equally symbolic supersonic jet planes.

A TITANIUM SKULL MELTING FURNACE will be built by National Research Corp. for the Federal government. The furnace will be one of the largest vacuum furnaces of its type in the United States and will cost nearly $500,000 to design, build, and test operate. Designed for the production of titanium and titanium alloy ingots and castings, the furnace can also be used for the production of other difficult-to-handle metals such as uranium, zirconium, thorium and their alloys. With a quarter-ton capacity, the furnace will be able to develop temperatures more than on-third that of the surface of the sun and will operate at pressures of one-millionth of an atmosphere.

CERMETS AND INTERMETALLICS may lead the way in the development of many high-temperature applications. According to Dr. Clarence H. Lorig, of Battelle Memorial Institute. "In the development of materials for high-temperature load-bearing applications in heat engines, nuclear reactors, electronic components and other as yet unknown applications, the boundary between metals and ceramics will become much less distinct. There will be a new, intermediate family of materials based on intermetallic compounds."

ELECTRON BEAM MELTING AND CASTING are the newest techniques to be announced. The new method has been proved on a semi-works scale in a joint operation sponsored by Stauffer Chemical Co., Mallory-Sharon Metals Corp., and Temescal Metallurgical Corp. So far, titanium, zirconium, tantalum, molybdenum and columbium have been successfully melted and cast. High vacuum techniques must, of course, be used in conjunction with the new melting process. The metal is melted and cast in water cooled crucibles with no contamination from the crucible. Economics of the new process appear favorable. Columbium requires 3 to 4 KWH per pound to melt and tantalum about 6 to 8 KWH. In contrast, solid state sintering of tantalum requires 500 KWH per pound.



to die cast aluminum motor end-bells . . .

ABOVE: Operator removing end-bell casting from one of Emerson-Electric's new Model 400-N Clevelands. End-bell is 6¼" in dia. Weight of shot approx. 2½ lbs. A close-up view of the "as-cast" part is also shown.

BELOW: Cleveland Model 400-N with aluminum shot end. Also available as a hot chamber, zinc machine. Has 36"x40" die plates; 400-tons locking pressure, **strain gage tested.**

EMERSON-ELECTRIC AGAIN SELECTS MODEL 400-N

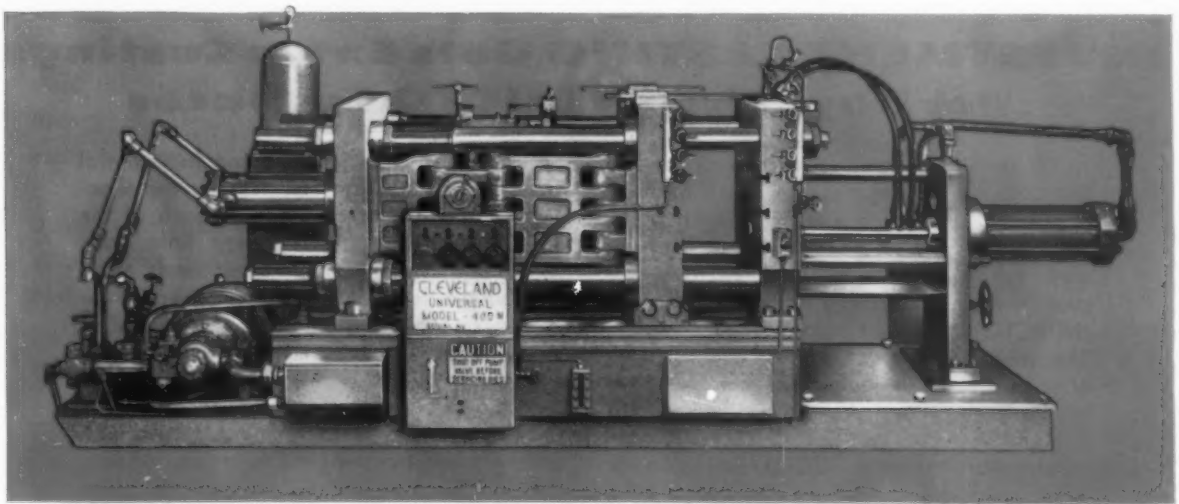
CLEVELANDS

The Emerson Electric Mfg. Co., manufacturer of Emerson-Electric motors and appliances, operates two Model 400-N Clevelands in their St. Louis plant, to cast aluminum motor end-bells.

Based on the excellent performance of these Clevelands, Emerson-Electric has recently installed *two more* Model 400-N Clevelands in their new, modern plant at Paragould, Ark. These new Clevelands are also producing aluminum end-bells in two-cavity dies.

For the Paragould installation, the new Model 400-N's were built as "right-hand" and "left-hand" machines; are located shot end-to-shot end. One operator controls both machines, ladling from a central furnace.

The nation's leading producers of die castings rely on *Clevelands* for dependable, profitable performance. Investigate their advantages for *your* production. Built in 50, 200, 400 and 600 ton capacities, for zinc and aluminum casting. For machine specifications, write for new Bulletin No. 5246.



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ANOTHER INDUCTO INSTALLATION...

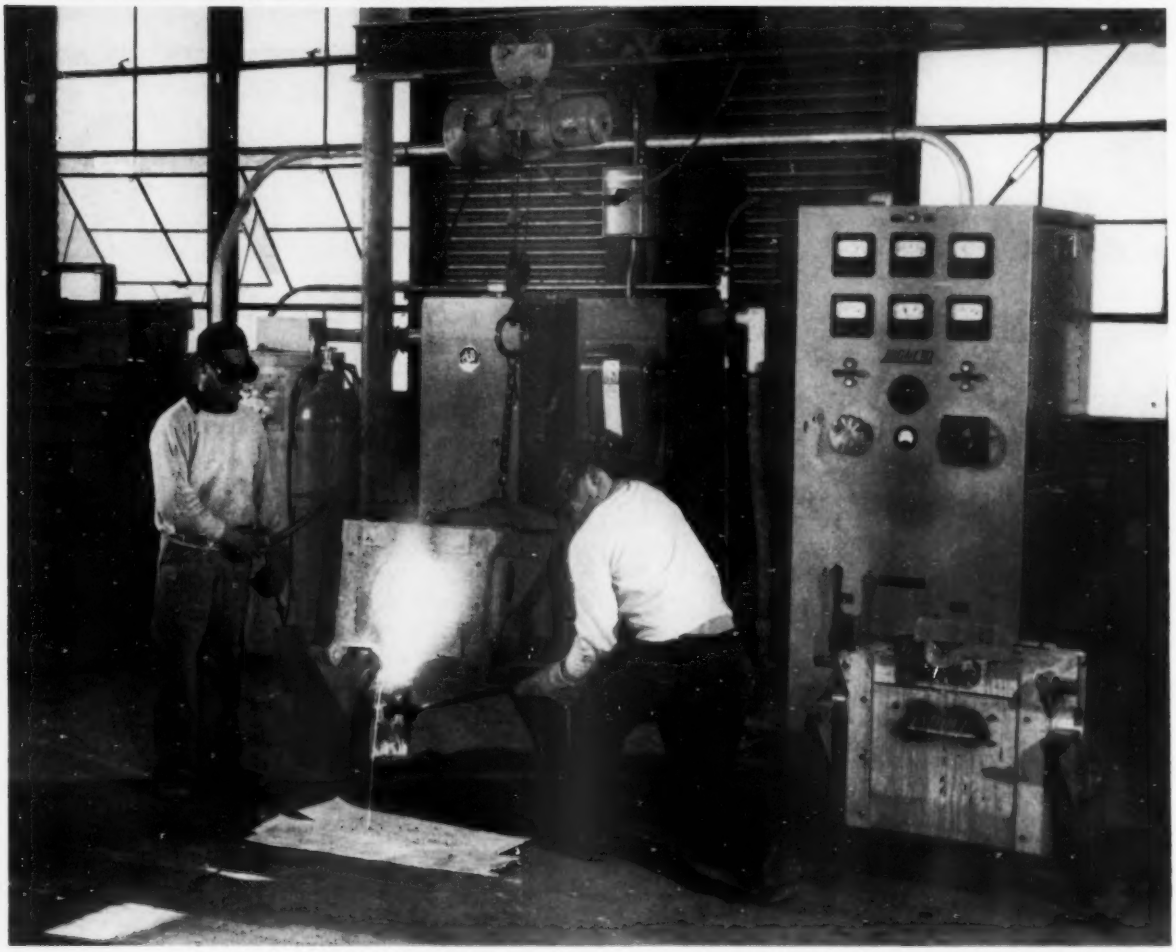

PHOTO COURTESY OF INVESTMENT CASTING COMPANY.

INVESTMENT CASTING Gets Extra Castings Per Day With INDUCTO Furnaces

The efficiency and performance of the INDUCTO high-frequency induction furnaces at Investment Casting Company, Springfield, New Jersey, account for extra castings per day. For in addition to high melting speeds and the resulting low metal losses, the INDUCTO equipment helps minimize rejects. The controllable analysis of alloys in heat after heat and the homogeneity of melts contribute to consistently higher quality castings.

Investment Casting Company benefits from other features of the INDUCTO melting equipment, too! The rugged welded construction of the furnace frame assures longer lining life through less distortion. The compact control panel puts all the controls, including the selector switches, within convenient reach of the operator while occupying very little floor space. The water-cooled power leads enter the furnace through the trunnion, thereby reducing twisting and flexing in addition to providing shorter leads for greater operating efficiency.

Why not learn how you, too, can save time and money through the use of modern INDUCTO metal melting equipment? Write today for Bulletin 70.

INDUCTOTHERM corporation

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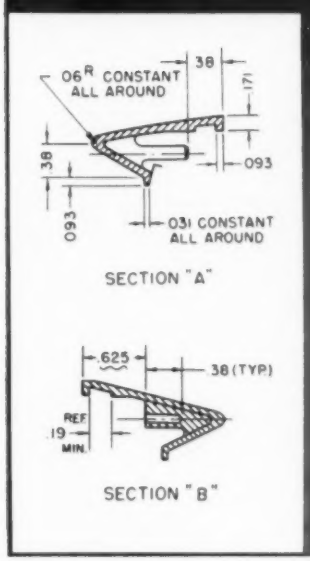
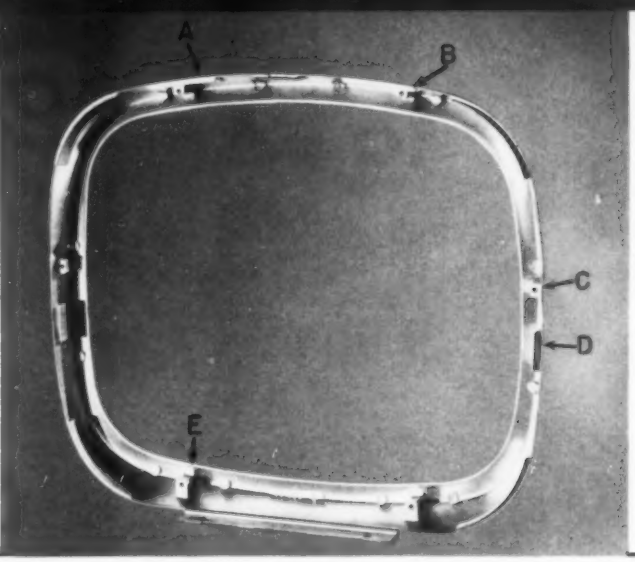
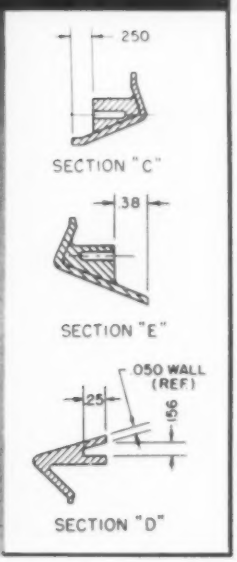
FOR *Light Weight with Strength*
ZINC DIE CASTINGS ARE BEST







RCA Victor proves that the lightest metals do not always produce the lightest weight parts. This RCA Victor Portable Television Receiver is built with a ZINC Die Cast bezel and screen mask that weighs less than one pound, yet provides the strength and rigidity necessary for a structural part of the entire housing.

The sharply edged brow, thin wall sections, streamlined shape, compound curves and built-in conveniences for easy assembly are possible only by the die casting process. Die cast of ZINC, this bezel meets every requirement for the modern styling of the RCA Victor Flight-Line Series of receivers.

HORSE HEAD SPECIAL ZINC AND ZAMAK ARE PRODUCED BY

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PLENCO SHELL MOLDING RESINS

These gear teeth are shown exactly as they came out of the mold

Want to cast a gear with the teeth already on it? Shell molding is your answer. And Plenco shell molding resins help make this answer a good one.

Advantages? Many! For example, the teeth on the sprocket shown above required no machining, no finishing. And they possess above average tensile strength, because the shell molding process enabled the manufacturer to work with tough, ductile iron rather than malleable grey iron.

You can well imagine what shell molding can mean cost-wise. Savings on labor. Savings on material. Savings on time.

Many industrial companies are eagerly turning to shell molding and Plenco shell molding resins to help them achieve these substantially lower production costs.

Interested in applying these production economies to your product? Call on Plenco. We'll show you how.

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FOR BETTER PLASTIC PRODUCTS

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LETTERS

the readers' forum

PLASTER MOLD CASTING

I understand that the suppliers of materials for the Plaster Mold Casting Industry have manuals giving full information on the materials used, methods of procedure, methods of making molds, and the operation of a plaster mold foundry.

Can you furnish me with the names and addresses of suppliers who have this information available. — R.D.P.

In addition to the companies who supply plaster for use in the plaster mold casting industry, there have appeared numerous articles in the trade press on how-to-do-it.—Ed.

FIBER METALLURGY

We are very much interested in an article which appears on page 132 of your January, 1958, issue regarding availability of fine metal fibers produced by a new process.

Can you advise us of a source of supply of these fibers. — R.D.T. Standards Engineer.

The fiber metallurgy process was developed on a commercial scale by the S.O.S. Co. Because there was so much interest in this process shown by our readers we asked the men who developed the process to write a full scale report for us. This report appears in this issue of PMM. —Ed.

BLACK ANODIZING

Would you kindly forward to us, tear sheets of the article "Here Are 10 Steps in Black Anodizing Aluminum Die Castings." This article appeared in the November, 1957 issue of PMM.

In the value analysis unit, we are constantly looking for new products or processes with the objective of obtaining the equivalent, or better, performance for less cost. Your article would be appreciated for our reference and file.—R.G.W., Value Analysis Engineer.

The entire aim of PMM is to present better or less expensive methods of doing a job. Letters like this one make us feel that we are accomplishing our purpose.—Ed.

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HELP

PROTECTION The fire-resistance of CARBIDE's fire-resistant hydraulic fluids has been proved by severe, exhaustive laboratory tests. And, in actual service, water-base UCON hydrolubes have prevented serious fires and injuries during more than 10 years of routine use in all types of industrial hydraulic equipment. The common fire hazards connected with hydraulic operations are eliminated when UCON hydrolubes are used. UCON hydrolubes are classified as acceptable, less hazardous fluids by Factory Mutual Laboratories.

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Why not get all the facts on how UCON hydrolubes can mean protection plus economy for you. Write today for the booklet, "UCON Hydrolubes Spell Safety," F-40134.

UNION CARBIDE CHEMICALS COMPANY

Division of UNION CARBIDE Corporation

30 East 42nd Street, New York 17, N. Y.

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For more information circle No. 98 on the Reader Service Card

"THERE'S A REASON FOR OUR ENTHUSIASM . . ."

"Our H-P-M's Give Us Better Quality Castings and Less Scrap . . . Consistently"

Kiowa Corporation, Marshalltown, Iowa, says, "The advanced principles of the H-P-M die casting machines have solved many of our quality problems and our day-to-day die maintenance problems have been reduced. We have two 200 ton, two 600 ton and another 600 ton H-P-M on order."

The new H-P-M die casting machines offer unlimited possibilities for die casting improvements. Here are the reasons: H-P-M's link wedge mold clamp locking mechanism pre-stresses the machine frame so that when metal is injected at high speeds and pressures, the mold is firmly clamped. Frame deflection is minimized due to the "beef" in platen and tie rods. Casting dimensional tolerances and density factors are held; flash is reduced to the minimum; scrap loss is practically nil.

Another important advancement, H-P-M's injection speed control, is infinitely adjustable for acceleration, high speed and pressure follow-through. Intricate detail is accurately reproduced; surface finish is greatly improved; pressure follow-through packs metal for high density.

Remember—for top quality die castings . . . better density control . . . uniform finishes . . . less scrap . . . more year-'round success and satisfaction—H-P-M die casting machines are 'way ahead of the field. Write for Bulletin 5400-J and get the complete facts.

H818

THE HYDRAULIC PRESS MFG. COMPANY

A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U.S.A.

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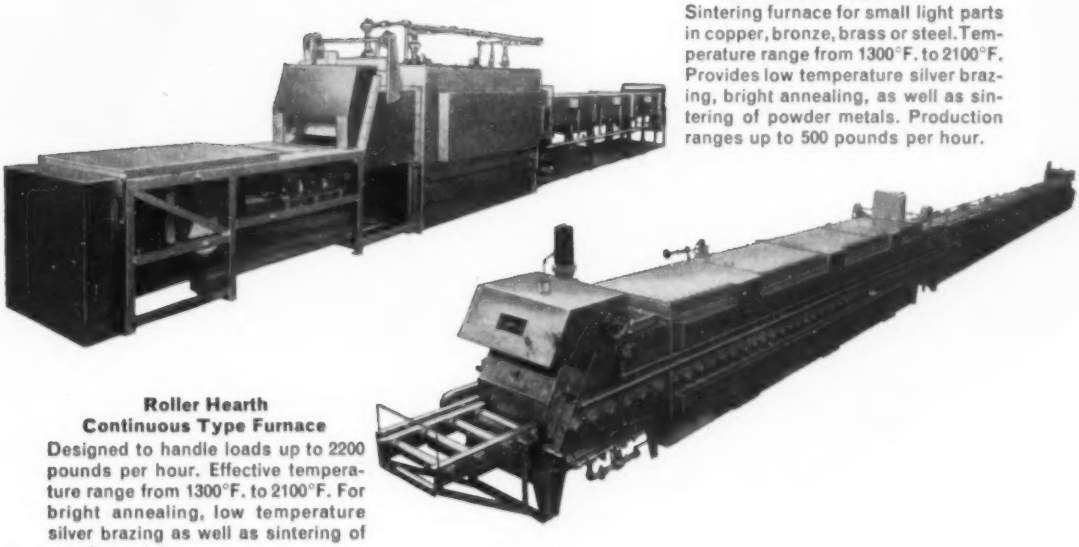
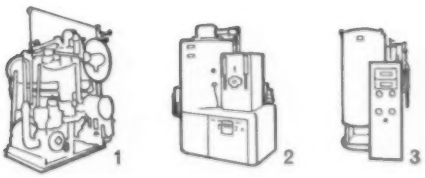
Look to Lindberg for sintering furnaces

Hand Pusher Batch Type Furnace
For small production lots and experimental sintering. An all-purpose unit for operation from 1300°F. to 2500°F. Made in various sizes for sintering from 25 to 300 pounds per hour.

Mesh Belt Continuous Type Furnace
Sintering furnace for small light parts in copper, bronze, brass or steel. Temperature range from 1300°F. to 2100°F. Provides low temperature silver brazing, bright annealing, as well as sintering of powder metals. Production ranges up to 500 pounds per hour.



Roller Hearth Continuous Type Furnace
Designed to handle loads up to 2200 pounds per hour. Effective temperature range from 1300°F. to 2100°F. For bright annealing, low temperature silver brazing as well as sintering of powder metals.



Lindberg atmosphere generators provide the proper atmospheres recommended for use with Lindberg Sintering Furnaces. These are: 1. HYEX Generator... approximately 4% carbon dioxide—18% hydrogen—12% carbon monoxide and 66% nitrogen. 2. HYEN Generator... neutral atmosphere approximately 21% carbon monoxide—40% hydrogen—38% nitrogen and 1% methane. 3. HYAM Generator... composed of approximately 75% hydrogen and 25% nitrogen.

For sintering furnaces, just as in all types of industrial heating equipment, you can depend on Lindberg's ability to supply exactly the right equipment for your needs. Just get in touch with your nearest Lindberg Field Representative, or write Lindberg Engineering Company, 2463 West Hubbard Street, Chicago 12, Illinois. Los Angeles Plant: 11937 South Regentview Avenue, at Downey, California.

See Lindberg in Booth No. 12, Metal Powder Show in Philadelphia

LINDBERG heat for industry

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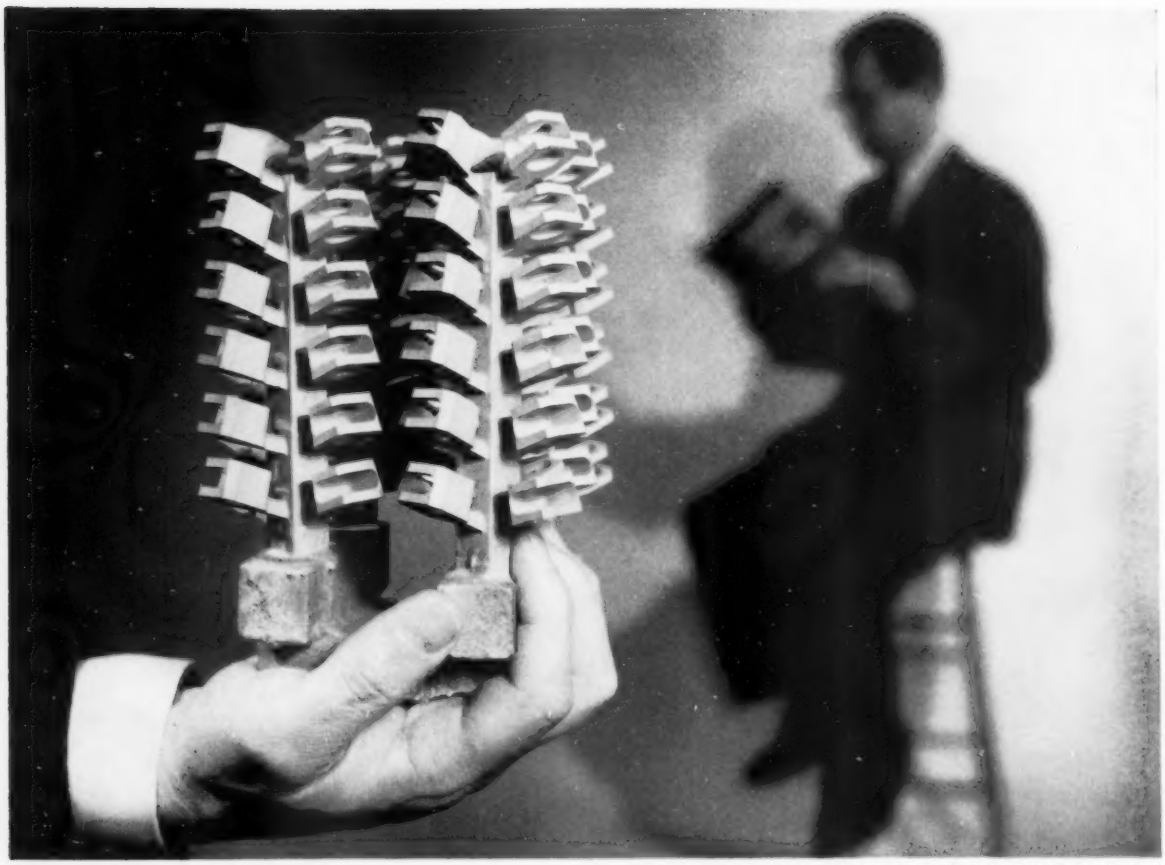

Castings by Alloy Precision Castings Co., Cleveland

In PMM in June, the 3rd Annual . . .

INVESTMENT CASTING DIRECTORY

Again . . . an issue of particular interest to buyers and producers of investment castings, alloys and related equipment. It's the Third Annual Investment Casting Directory in the June issue of PRECISION METAL MOLDING. This is the only available buyers' guide listing all producers of investment castings, plus the equipment and materials for making them.

Special Reader Attention for Advertisers—advertisers receive bold-face listing in all places in the Directory where their names appear.

If you want to give your investment casting advertising an extra boost, place it in the June, 1958 issue of PRECISION METAL MOLDING. Your message will be delivered when buyers seek investment casting information.

REGULAR RATES APPLY . . . FORMS CLOSE MAY 5TH . . . RESERVE SPACE NOW!

PRECISION METAL MOLDING AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

812 HURON ROAD • CLEVELAND 15, OHIO • SUperior 1-9622

SALES OFFICES: NEW YORK CHICAGO LOS ANGELES LONDON, ENGLAND

hold your fire

On those days when nothing goes right in the shop, a wave of temptation may sweep over you to fire the whole crew. But you don't, because part of your job is juggling problems.

Some die casters juggle more trouble than they need to—the problem of getting clean castings out of the machine (hopefully intact) is a case in point. Many die casters turn their attention to other problems because they standardize on Die Slick. They keep several grades on hand to have something new to try when job requirements change.

And by blowing $1.60 on a three-minute phone call from Dallas to us here in Dayton, a die caster can usually avoid a peck of grief and experimenting when the problem deals with die casting compound. It's not that we're so all-fired smart, but we *have* experimented and we *have* helped die casters solve more problems than any single die caster is likely to turn up. That goes for married die casters, too.

Are you up on the newest Die Slick compounds? We may have a surprise or two for you if you drop us a line. Be sure to tell us the metal or alloy you are casting.

Cordially,

V. W. Smith

V. W. Smith

Don't use farce...use Die Slick!

Stuck castings, scoring or soldering can create problems when you start to die cast aluminum. Heat requirements are higher, for example, and can obsolete your zinc die casting compound fast. That's why most aluminum die casters end up using Die Slick in the last place, if not in the first place.

Die Slick *aluminum* compounds withstand high heat, and have the added advantage of being thixotropic. This property lets you dilute Die Slick without the thinner rising to the top next morning. And while it has the consistency of heavy cream, it brushes or sprays on like water.

Tell us the metal or alloy you are casting and we'll rush you a trial quantity. If you don't like it for any reason, tell us and we'll make confetti of the invoice.

Die Slick is a registered trade mark of G. W. Smith & Sons, Inc.

DIE SLICK

used by die casters everywhere

G. W. SMITH & SONS, INC., 1703 SPAULDING ROAD, DAYTON 3, OHIO

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precise heat for precision casting

You'd *expect* the accurate heat of an induction furnace to be an important consideration in permanent mold, shell mold, and investment casting . . . and it *is!* But in addition to precise temperature control, Ajax-Northrup high frequency induction furnaces provide the precision foundry with *flexibility*, *purity*, and *economy*. That's why Ajax leadership in melting for precision casting has never been challenged.

One furnace—hundreds of alloys: Ajax-Northrup furnaces can handle any one or all of the hundreds of ferrous and non-ferrous alloys being made today. For many alloys, it's the only furnace that *can* be used. Magnet alloys, for example, depend on the inherent stirring action which assures ideal dispersion of all elements throughout a melt . . . and the most uniform possible cast part analysis.

Pure metal protects part quality: There's no flame, no smoke, no physical contact between coil and metal. Melts are always 100% on analysis, because there's no chance of contamination . . . particularly important when you're dealing with the finicky alloys common in precision casting.

A better melt at a lower cost per melt: Because every melt is uniform and to exact composition, bad melts become a thing of the past. Subsequent machining is minimized. Ajax-Northrup's unique control system assures maximum melting efficiency—lower melting costs. And new, compact designs minimize floor space requirements, installation costs and maintenance.

Induction heating & melting

AJAX

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Available in every conceivable capacity from a few ounces to several tons . . . powered by massive motor-generator sets or economical converters . . . there's an Ajax-Northrup induction furnace sure to satisfy your needs perfectly. We'll gladly send you further information or, if you wish, arrange a meeting with qualified furnace engineers to discuss your special requirements. Ajax Electrothermic Corporation, Ajax Park, Trenton 5, New Jersey.

ASSOCIATED COMPANIES: AJAX ELECTRIC COMPANY-AJAX ENGINEERING CORPORATION

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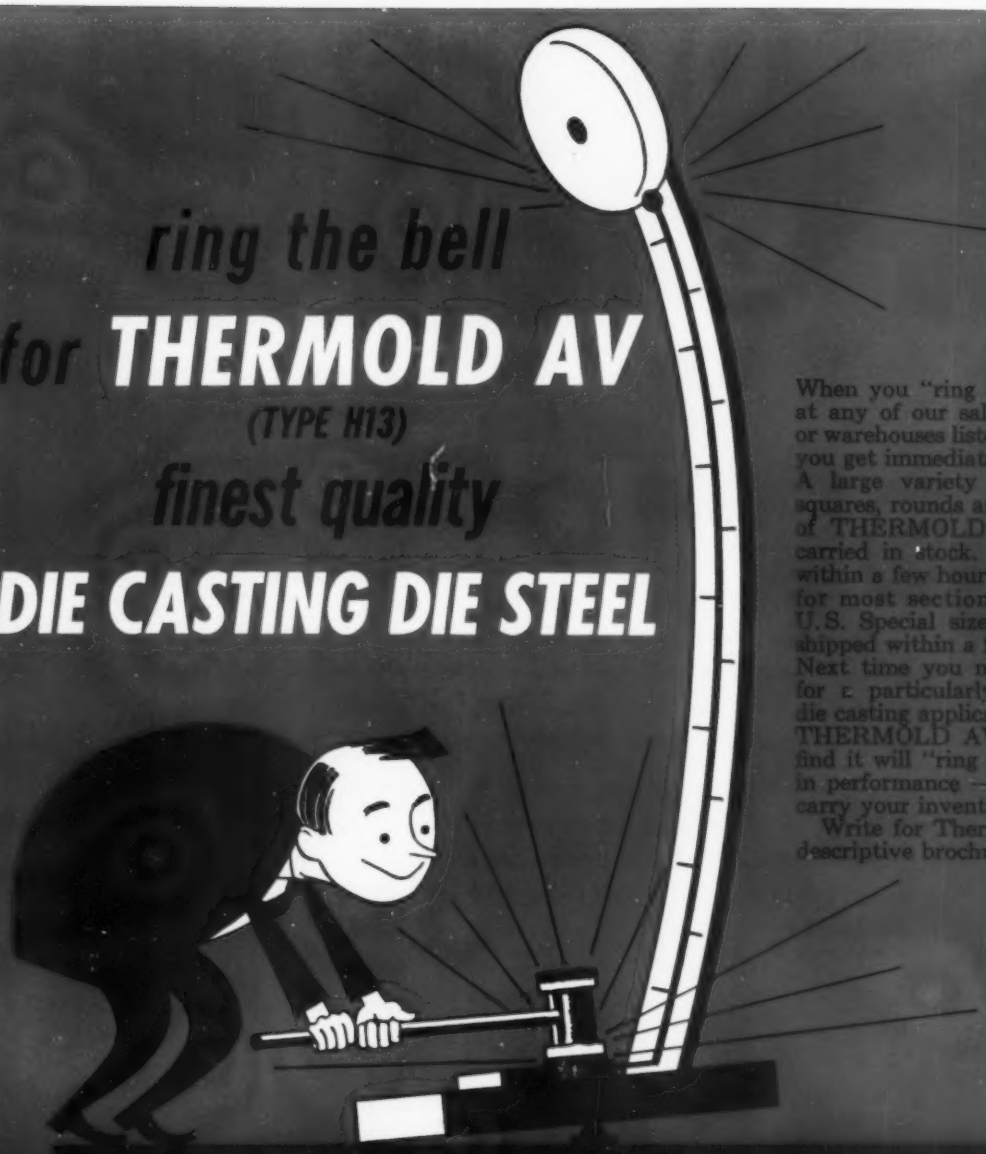
ring the bell for THERMOLD AV (TYPE H13) finest quality DIE CASTING DIE STEEL



When you "ring the bell" at any of our sales offices or warehouses listed below, you get immediate service. A large variety of flats, squares, rounds and billets of THERMOLD AV are carried in stock. Delivery within a few hours is usual for most sections of the U.S. Special sizes can be shipped within a few days. Next time you need steel for a particularly critical die casting application, try THERMOLD AV. You'll find it will "ring the bell" in performance — and we carry your inventory.

Write for Thermold AV descriptive brochure.

CALL ANY OF THESE WAREHOUSES AND OFFICES

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Cleveland	LAfayette 4-4444	New York	WOrth 4-1970	St. Louis	MIssion 7-4733
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USCO Z-3 (an aluminum-magnesium hardener) and USCO Z-5 (an aluminum-magnesium-copper hardener)—in either shot or ingot form—will give you manufacturing economies in producing your No. 3 and No. 5 Zinc Die-Casting alloys respectively, for hot metal delivery to your casting machines.

Analyses are carefully controlled so that your final alloy will conform to all existing governmental and society specifications. Our metallurgical engineers are available to discuss the exact use of USCO Z-3 and Z-5 hardeners with you. Write us for details!

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UNIQUE
"ONE SOURCE" CASTING ANALYSIS
Offers "More Casting Value Per Dollar" in Monarch

✔ALUMINUM PERMANENT MOLD

✔ALUMINUM DIE CASTING

✔FUNCTIONAL ZINC DIE CASTING

Effective value analysis requires experienced judgement and knowledge of all methods involved. Years of experience in design and production of aluminum permanent mold, aluminum and zinc die castings, ready for assembly—enables Monarch to give you factual costs and impartial design analysis.

Save Time. Save Money. Contact Monarch on your casting requirements. Monarch produces the finest castings that can be made by each method. Send today for our new brochure—"Manufacturing Achievements in Molten Aluminum".

MANUFACTURING ACHIEVEMENTS in MOLTEN ALUMINUM

MONARCH ALUMINUM MFG. COMPANY
9205 Detroit Avenue Cleveland 2, Ohio

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OPPORTUNITIES

jobs & equipment

Opportunities rates: $20 for the first column-inch; $15 for each additional column-inch payable in advance. To answer box number advertisements, address responses to the box at Precision Metal Molding, 812 Huron Rd., Cleveland 15, Ohio. Closing date: 1st day of month preceding publication.

POSITIONS OPEN

MFGRS. REPRESENTATIVE—Established Powdered Metal Parts Manufacturer in Eastern U. S. looking for aggressive representation on commission basis in Metropolitan Chicago Area, Michigan, and West Coast States. Write complete resume to Box No. 4158.

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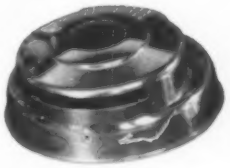

Gleaming Polish highlights many of today's "best-selling" products produced from Monarch aluminum permanent mold and diecastings.

Colorful Porcelain Enamel offers a modern decor to create "buy appeal". "Porceglaze" economically adds a new feature to products made from Monarch permanent mold castings.

Durable Velvaglaze provides a pleasing, economical scar and mar resistant finish on both Monarch aluminum permanent mold and diecastings.

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MANUFACTURING ACHIEVEMENTS in MOLTEN ALUMINUM

MONARCH ALUMINUM MFG. COMPANY
9205 Detroit Avenue Cleveland 2, Ohio

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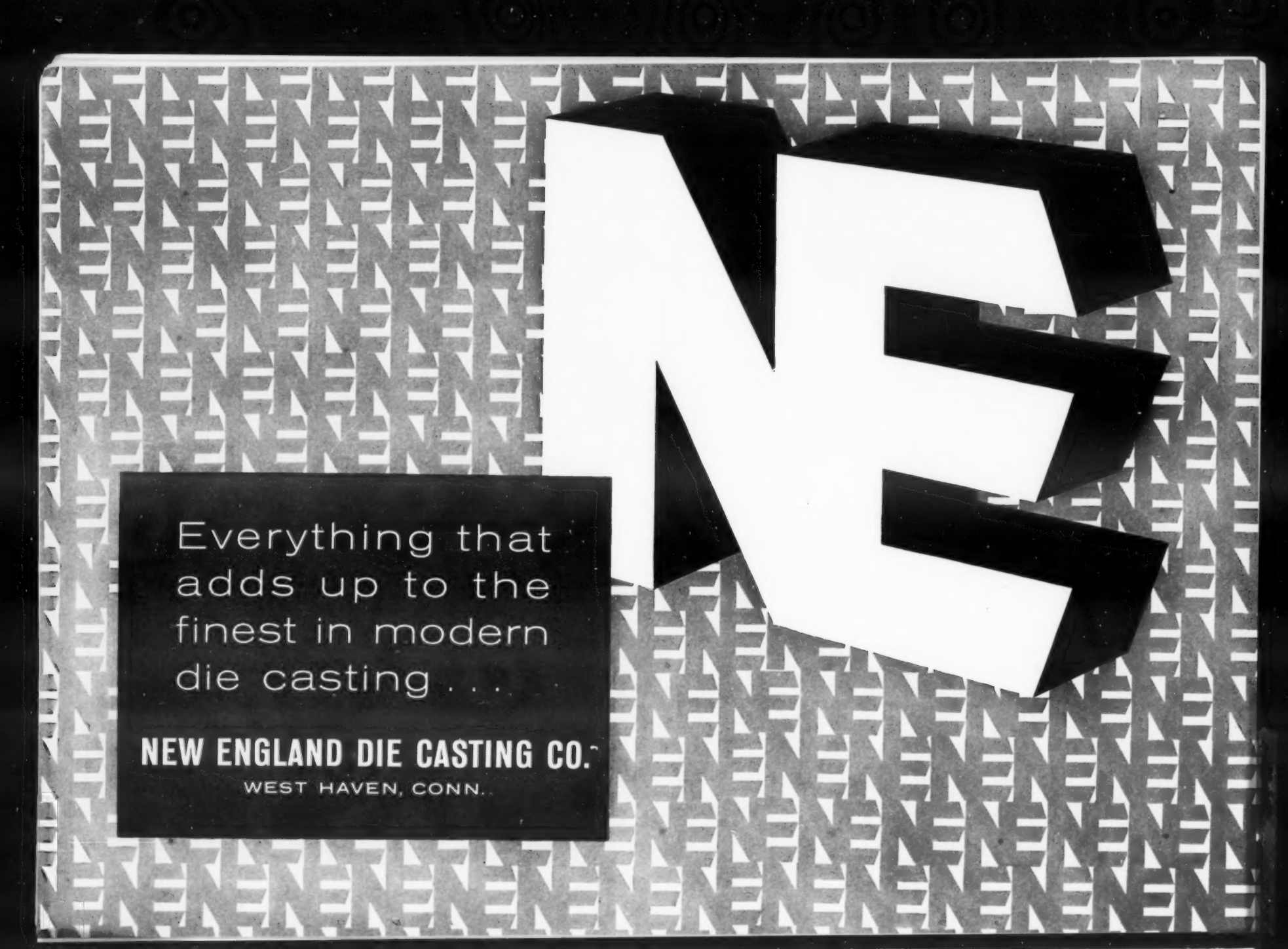

NE
Everything that adds up to the finest in modern die casting . . .
NEW ENGLAND DIE CASTING CO.
WEST HAVEN, CONN.

Now — a complete report on a new process and new products made by . . .

Fiber Metallurgy

By R. H. READ*, W. POLLACK and S. W. McGEE**

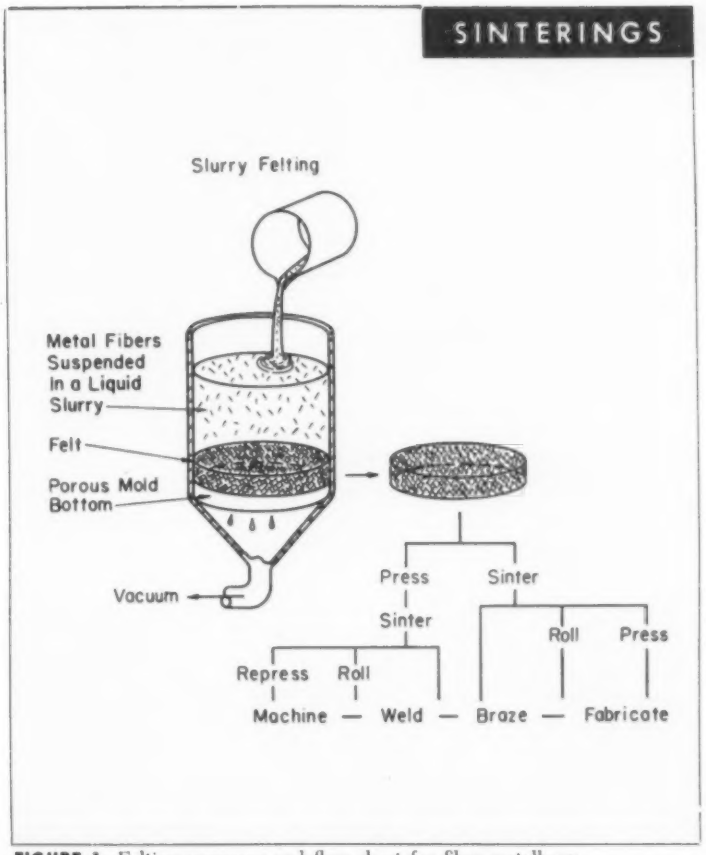


FIGURE 1. Felting processes and flow sheet for fiber metallurgy.

I. INTRODUCTION

NEW engineering materials are now possible because of fiber metallurgy. Processes for manufacturing a new class of porous metal products having high strength as well as high permeability and a new series of composite materials such as plastics, ceramics or soft metals reinforced by fiber metal networks have been developed at the Armour Research Foundation.

The porous metal products can be manufactured in the form of continuous sheet or in intricate shapes.

They promise to become a valuable material for the filter industry as well as for special structural applications. The fiber metal base composites combine the features of a metal network with the density, refractory, corrosion or other desired properties of a second material and permit materials design for unusual service conditions.

*Asst. Supervisor, Powder Metallurgy, and **Associate Metallurgists respectively, Armour Research Foundation, Chicago, Illinois

II. THE MANUFACTURE OF POROUS METAL PRODUCTS

A. Fiber Sources

Metal fibers are obtained by chopping or cutting into discrete lengths, metal filaments, wires, or metal wool strands. An economical process has been developed for making fibers by chopping batts of metal wools which are manufactured by a shaving or scraping process.

The range of fiber sizes from which useful porous materials can be made is very broad, but most fibers have diameters from 0.001" to 0.020" and lengths from 0.03" to 1.0". Fibers made from wires have regular cross sections and smooth surfaces while those from wools are irregular in cross section and have rough surfaces.

B. Metal Fiber Felting

The diagram shown in Figure 1 illustrates typical felting procedures. For the slurry felting method, the metal fibers are beaten into a slurry with a viscous fluid. The slurry is charged into a porous felting mold and the mold is subjected to a vacuum. The vacuum pulls the liquid through the mold and fibers are deposited randomly on the inner mold surface.

Uniform felting is assured because, if fibers should build up excessively at some site, the permeability of that site for the felting medium would decrease and felting would proceed less rapidly at that site. The slurry would then flow to sites where permeability is high and more fibers are needed to provide a uniform felt.

The product of felting is a very porous metal body having a density of from 5% to 20% of that of the metal from which the fibers are made. The density is dependent upon the size of the fibers, the felting medium and the felting rate.

In general, short fine fibers will felt to the highest density. The felted metal fibers are interlocked with one another and the felt has sufficient strength to permit handling. Rough, kinked fibers from metal wools interlock more effi-

FIGURE 2. Typical forms that can be produced in fiber metal.

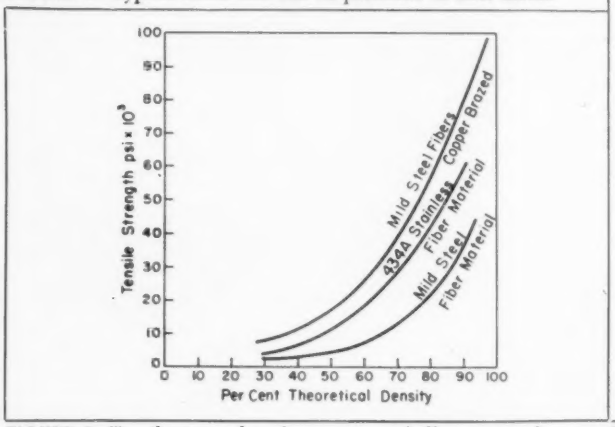

Tensile Strength psi x 10³
Per Cent Theoretical Density
Mild Steel Fibers Copper Brazed
434A Stainless Fiber Material
Mild Steel Fiber Material

FIGURE 3. Tensile strengths of porous metal fiber materials.

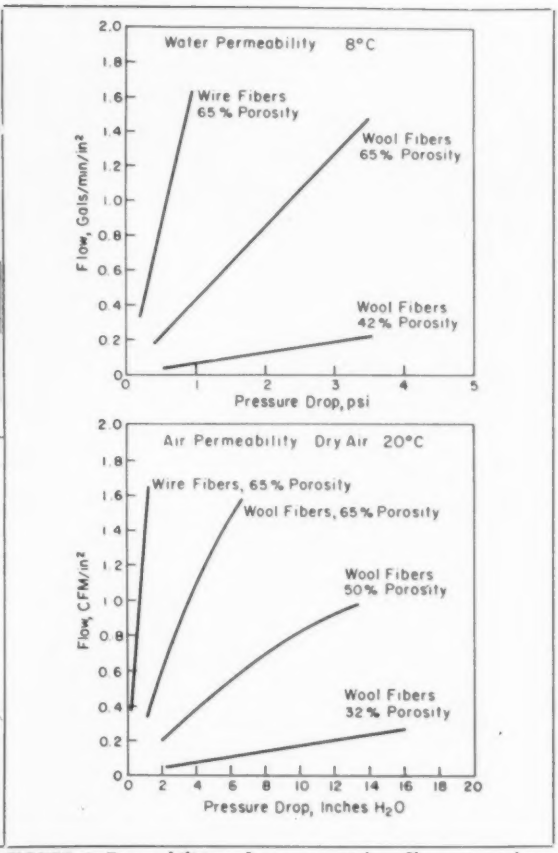


FIGURE 4. Permeabilities of porous stainless fiber materials.

ciently than fibers from metal wire.

C. Sintering Felted Fibers

The sintering of metal fiber felts is very much like metal powder sintering. There may be a considerable difference in the size of the parts to be sintered, however, for the size limitations imposed on powder metal parts are not a problem in fiber metallurgy. Fiber felts can be small and intricate, but they can also be in the form of large sheets or blocks.

For example, the size of felts made by permitting fibers to fall through the air into a mold can be almost unlimited.

Felts may be sintered in the as-felted condition or may first be compressed to a predetermined density. The pressing loads required increase for increasing final density requirements but are very low for the manufacture of porous materials.

Sintering temperatures and protective atmospheres are similar to those for metal powders of the same alloy. Sintering temperatures can be reduced for many metals by "brazing" the fibers together with a lower melting alloy.

For example, a surface coating of copper can easily be deposited on the strands of a steel wool batt. If the wool is chopped into fibers which are subsequently felted, the felt can be "brazed" by sintering at a temperature sufficient to melt the copper.

D. Rolling or Press Forming

Sintered fiber metal felts are easily rolled or pressed to obtain a desired density, strength or shape. The amount of deformation permissible is dependent upon the alloy used; ductile metals can be rolled to complete density as would be expected from the success of roll bonding metal powders of iron, nickel and other metals.

If intricate, porous parts are desired, the felts should take the shape of the finished part because non-uniform deformation of the felt causes non-uniform permeability of the part.

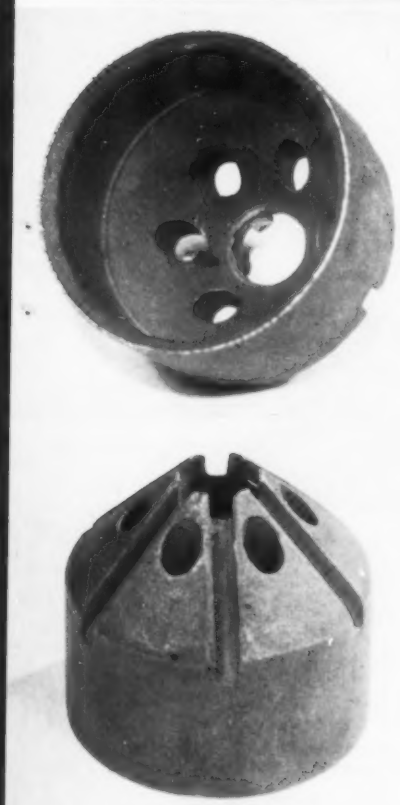
Fiber metal parts can be machined to final dimensions, though care must be exercised to avoid smearing their surfaces if surface porosity is desired. Very porous parts should be filled with wax or resin to permit machining. The filler can be subsequently removed.

The final product is a porous fiber metal material somewhat analogous to a three dimensional metal screen, though not so regularly oriented. Normally the fibers are randomly oriented but can be partially oriented to provide directional properties. The porosity of the fiber metal product ranges from 5% to 95%, and pore sizes range from a few microns to a few millimeters.

An important feature of the fiber metal process is economy. A process for felting continuously from a slurry onto a rotating drum has been developed for the manufacture of continuous sheet. Felting in porous molds requires very simple equipment and is amenable to automation.

The most economical source of

continued on page 53



INSIDE view of cap nose wheel rebound is seen at top; outside view of same casting is below.

NOSE WHEEL of the Beechcraft Model H-35 Bonanza. Shock absorber on this part has cap-nose wheel rebound, see left, which is investment cast.
(Photos: Courtesy, the Beech Aircraft Corp.)

Part Three Beech Aircraft Specifies...

Investment Castings in the H-35

CIVILIAN aircraft are fitted for flight in peaceful air where speed is a factor of convenience . . . not pursuit or escape.

Accented in every part of each of these planes are the characteristics of comfort, customer appeal, and last but not least, operation at a reasonable profit.

Investment castings are penetrating this area of aircraft manufacturing. One of the first to be used in this more or less specialized field was chosen by the Beech Aircraft Corporation of Wichita, Kansas, for use in its popular Model H-35 Beech Bonanza.

The name of the investment-cast part is the Cap-Nose Rebound Wheel and it is designed to function specifically as a shock absorber inside the nose-landing wheel. This is part of the retractable landing gear contained in the forward part of the ship during flight.

As the plane lands, the nose-landing gear drops into position at the same time that the other two are released. At the instant of touchdown, these structures must remain functioning under the full shock of contact.

This model of the Beech Aircraft Bonanza is a single engine plane, carrying up to four passengers. Designed, and used mainly as a business plane, the compactly built aircraft travels at a top speed of 200 miles per hour.

Cast to specific tolerances, the part's dimensions are 1¼" in diameter. Its height is 1⅛".

These parts are forerunners of other investment castings which will be specified for civilian-commercial aircraft by future designers.

Already, engineers are basing conclusions on parts such as those illustrated on this page, and realizing that investment castings have promising potential in the commercial plane field.

Convair and Aerojet avoid machining by using...

Investment Castings for Special Parts

HORN for landing gear fairing on the F-102A and TF-102A.

CAM is designed for use on the external fuel-tank release.
(Photos: Convair Div., General Dynamics Corp.)

AIRCRAFT make use of many specialized investment cast parts which would be impossible to make by any other method. These parts are usually produced in one piece and need little, if any machining.

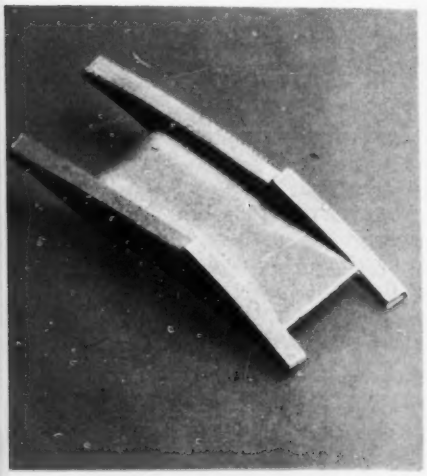
Samples above from the Convair Division of the General Dynamics Corp., and below from the Aerojet-General Corp., illustrate parts made by this process.

The horn, upper left, is an uplatch horn for the main landing-gear-fairing on Convair's F-102A and TF-102A. Because of the high heat treat, 190,000 psi to 200,000 psi, permanent steel stamping of the X-ray number on the part was delayed.

Cast in #410 stainless steel, the parts were made by the investment process because it allowed holes to be cast true.

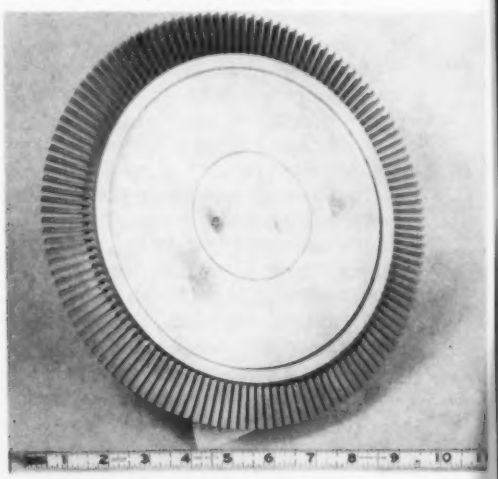
The cam, upper right, for the external fuel tank release mechanism, is cast in No. 4130 chrome molly-steel. Aerojet-General part, seen below at left, is a casting segment in the first stage turbine nozzle. It was originally designed as an investment casting made of Multimet N-155. Seen in center is a casting adapter cross-over coolant cast in 347SS. At right is a rotor turbine, sceond stage, cast in Haynes Stellite No. 31.

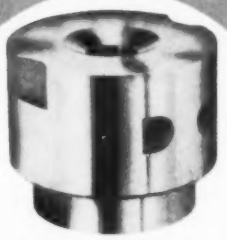
CASTING segment, turbine nozzle.



ADAPTER cross-over coolant.

ROTOR turbine cast to tolerance.
(Photos: Aerojet-General Corp.)





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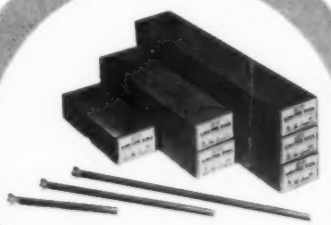

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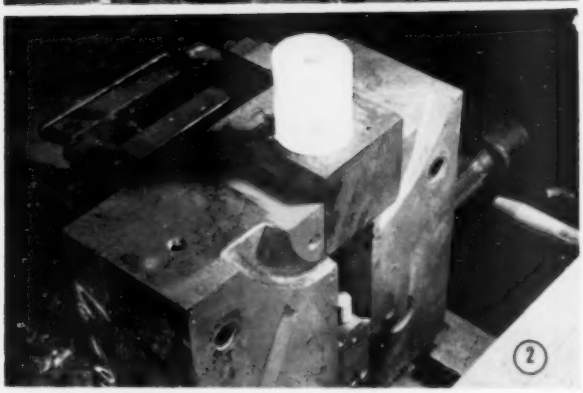


TYPES OF PERMANENT MOLDS are seen above. Fig. 1 shows a small, vise-held, manually filled mold. Fig. 2 illustrates an intermediate mold with a rack and pinion for opening. Fig. 3 is a large, hydraulically operated mold.

Designing for Aluminum Permanent Mold Castings

Part Two: Advantages and Limitations

By P. R. KALISCHER, Editor

THE permanent mold process has distinct advantages when it is properly applied. It allows a latitude of design unequalled by any other casting method. When used intelligently, many major manufacturing economies are possible.

But at the same time this method has its limitations. If parts are designed without considering these limitations, advantages can be easily lost.

Editor's Note: *Part Two describes important details of the permanent mold casting process, gives its advantages and limitations, and illustrates the various ways of making the castings.*

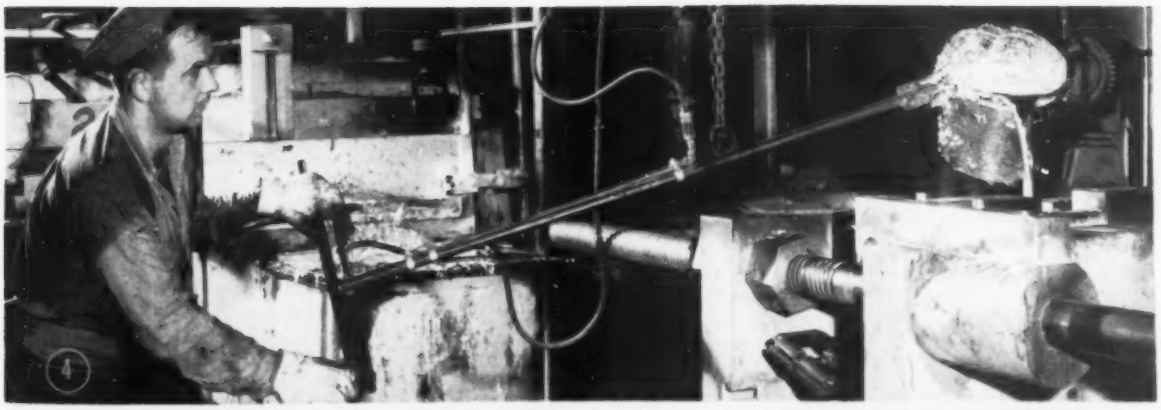
ADVANTAGES

1. GRAIN STRUCTURE—Lighter parts with thinner wall sections can be designed and cast because permanent mold castings have finer grain structure and better strength properties than sand castings of the same alloy. This is due to the fact that permanent mold castings cool faster. Cooling rates are controlled.

2. SMOOTHER SURFACES—A machining-allowance may not be required because the "as cast" surface of the casting can be used when this surface-finish is important. This gives a saving in labor-costs and metal. Also, no machining means that the chilled skin of the casting is saved. The surface finish of a permanent mold casting is always better than a sand casting surface.

3. SOUNDNESS—Permanent mold cast parts are stronger, more pressure tight, and less subject to notch sensitivity when properly made because they shrink less and have less gas porosity than sand castings.

4. ACCURACY—Closer tolerances can be held and reproducibility from casting to casting is superior. As a result the amount of finishing which must be done to permanent



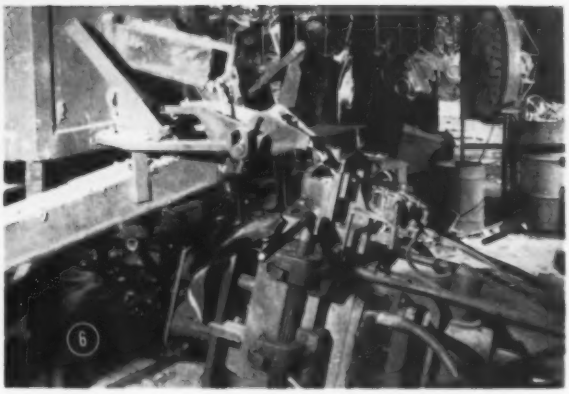


FIG. 4 displays a large mechanically operated pouring ladle and mold. Fig. 5 shows hydraulically operated molds on a turntable which are poured manually. Fig. 6 pictures a large turntable of molds being poured automatically.

mold castings is considerably less than is required on sand castings. In some cases, dimensional accuracy is good enough so that machining operations may be eliminated. Permanent mold castings are always more accurate dimensionally than sand castings.

5. CORING—Four different types of cores are common and each has advantages.

Metal Cores: These are always used for straight-pull cores. They are permanent, dimensionally accurate, and stable. There is no possibility for core-shift or core-wash, two serious problems when the sand casting process is used.

Sand Cores: Standard sand cores are used for complex cores that cannot be pulled straight. Only the cored holes will lose the accuracy of permanent mold casting. By using them, it is possible to make a permanent mold casting that, otherwise, would have to be cast in a green sand mold.

Plaster Cores: When accuracy and a superior surface are demanded for a complex cored hole, plaster cores, while more expensive to make and remove, are far superior to sand cores, allowing no core-wash and having much less tendency to shift during pouring.

Shell Cores: This newest core material is resin-bonded sand which forms a so-called "Shell Core". Strong and rigid, these cores can be made smaller and more complex than sand cores. Surface-finish may not be as fine as that produced with plaster cores but dimensional accuracy of both types is about the same, thus where shell-core making equipment is available, shell cores are replacing sand.

Regardless of the type of core used, considerable economies are shown because of the superior acuracy and surface produced by permanent mold castings.

6. REPRODUCTION OF DETAIL—Because the molds are rigid and because flaking and spalling of the mold is completely eliminated, lettering, numbers, and engraving can be accurately reproduced if designed so that gravity-pressures give proper metal-fill during pouring. Permanent mold castings reproduce much finer detail than is possible with sand casting.

The engineer designing for permanent mold casting must know the practical requirements of the mold-cavity. Unless he has actual permanent-mold foundry experience, the designer will be able to do a better job if he will consult with a permanent mold foundryman.

Like every other metal-forming method, permanent mold casting has limitations. To design without knowing them is certainly asking for trouble.

LIMITATIONS—and Alternatives

1. UNUSUAL PROPERTIES—A need for unusual soundness, or a demand for higher than as-cast and heat-

continued on page 32

DESIGNING

continued from page 31

treated properties, may make it desirable to use a forging or an assembly of welded wrought-components instead.

2. MAXIMUM DETAIL AND SOUNDNESS—When unusual detail and great soundness are required, the investment casting process might be the most economical.

3. VERY FINE DETAIL-MODERATE SOUNDNESS—If reproduction of fine detail is needed and physical properties associated with die castings are adequate, better parts will be secured by die casting.

4. VERY SMALL PARTS—If the cast parts are so small that a large number can be gated on a match plate, sand casting with fast production molding machines might offer a few economies. Shell mold casting may be much more economical. Greater dimensional accuracy of shell mold castings and a much better surface can be secured at high rates of production by the manufacturer.

5. LONG RUNS—When the number of castings required is quite large and when the soundness and mechanical property requirements can be met, die-casting is the preferred method of fabrication.

6. SIZE—As size increases, tooling costs also increase and foundry difficulties multiply. Some permanent mold castings have been cast that weigh as much as 500 lb. and castings up to 100 lb. are not uncommon, but the majority of permanent mold castings weigh less than 20 lb.

The few advantages and limitations listed in this article simply emphasize the designer's need to be extremely familiar with the permanent mold process before he specifies a permanent mold casting.

Most foundries are staffed with competent engineers who will advise prospective customers, will help them on specific design problems, and suggest design modifications that will insure sounder, stronger castings.

It is well worthwhile to use these services.

Following advice and considering suggestions when they are made to him can save the prospective customer a lot of time. He may also avoid wasting money investigating other processes which are not adaptable to his specifications.

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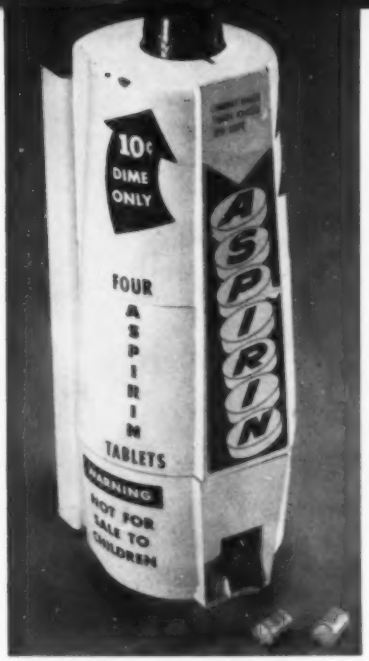
SOCIETY OF DIE CASTING ENGINEERS ELECTS OFFICERS

The Society of Die Casting Engineers, Inc. have announced the new officers for 1958. They are: Harry Cagin, Halex Die Casting Co., president; Dean L. Rockwell, Clifford Rockwell Co., vice president; Meyer R. Tenenbaum, Lester Phoenix, Inc., executive secretary; John Lapin, Saginaw Industries, Inc., director, 3 year term; Herman J. Windolp, Holland Die Casting Co., Inc., director, 3 year term; Harris R. Shimel, Cuyahoga Industries, Inc., director, 2 year term; and William Van Raaphorst, American Mold Engineering Co., director, 1 year term.

ROOSA ELECTED VICE PRESIDENT OF PARKER

Max B. Roosa, formerly vice-president in charge of sales, has been elected executive vice-president of Parker Rust Proof Co.



ASSEMBLED of precision made die castings, this coin-slot aspirin dispenser is dependable, durable, and resistant to atmospheric conditions found anywhere.

DIE CASTINGS used to make up the greater part of the aspirin dispenser. These parts were a challenge to designers who were used to conventional demands of the die casting industry.

Precision Parts Ease Pill-Dispenser Headaches

By SAMUEL FRADIN*

ALL "coin in the slot" dispensers have a common denominator. They must be made inexpensively, and they must operate faithfully and consistently.

It is not surprising, therefore, to find that most of the working parts of these dispensers are die cast. The aspirin dispenser seen on this page is typical of one type of coin-operated mechanism.

Except for the mounting bracket and a few incidental pieces, this entire unit is a group of zinc die castings.

While these may appear to be very simple castings, the three major housing segments are quite long and are cast with exceptionally thin walls. In the bottom section, relatively intricate coring is required to provide the slot for the delivery of the aspirin tablets and to provide for acceptance or rejection of the coin. The locking mechanism is also cast into this section.

Inside the housing sections are two multi-barrele ntainers which hold the capsules of aspirin tablets. Each of these segments is approximately 4" long and contains 15 tubes.

These two castings provide a challenge to the die caster because practically no draft could be allowed on the cores. The two sections must match exactly so that there will be smooth feeding of the contents across the joint.

Originally these various parts were designed as aluminum die castings. The change to zinc was necessary because of the inability of the foundries consulted to produce the multi-barreled storage sections with sufficiently straight sides so that b..ing was an unnecessary operation.

As the parts are now being made by the Caldwell Casting Company, only simple machine work is necessary to finish the parts. A few holes to accommodate self-tapping screws must be drilled and a slot cut in the bottom barrel storage-section to accept the delivery mechanism.

Had these castings been made by any method other than zinc die castings, many more operations would have been necessary to finish them.

*Project Manager, Miller Research Laboratories, Baltimore, Maryland.

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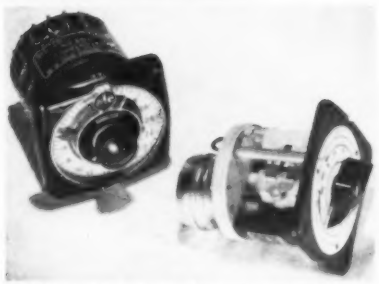
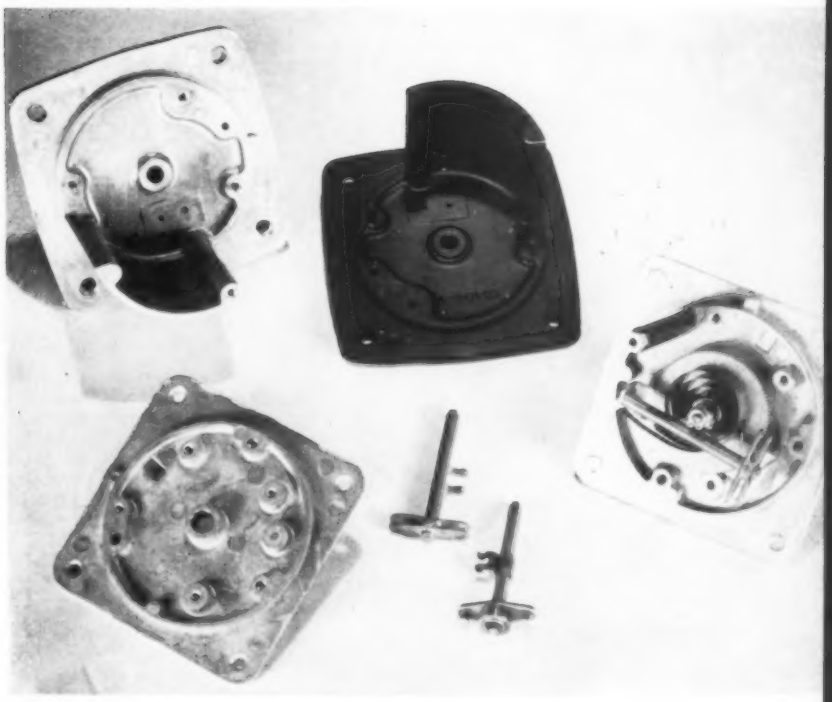
DIE CASTINGS



LOWER COSTS at both manufacturing and assembly levels are realized through the use of die cast components in these instruments. But this is only one of the advantages gained with this fabricating process.



CAST COMPLETE except for minor drilling and tapping; these castings give the buyer a better instrument at less cost.

For rigid construction and complete interchangeability of parts . . .

Use Die Cast Instrument Components

THE J-4A Input Controller, manufactured by Automatic Timing & Controls Inc., is a device used primarily for controlling the time that power is on or off on heating devices. It represents as complete a utilization of the flexibility of the die casting process as one could hope to find.

As this device originally was conceived, die castings were not considered at all. Instead, stampings and wrought parts machined to shape were used. The result was a conglomeration of small parts which had to be assembled, mostly by hand. The assembly seldom had the alignment or the rigidity desired for shipping purposes. It was necessary to match the various components and to keep these matched units together through subsequent manufacturing operations. Some of the early applications of the units clearly indicated that it was impossible, when using stampings and screw machine parts, to secure the necessary rigidity required in field use.

The housing of this Input Controller is now a zinc die casting with a separately molded terminal plate, so that the two parts fasten together with a bolted spacing bar and make up an assembly that will stay put through any normal and some abnormally rough service.

Drilling and tapping are the only machining operations needed on the castings. The result is that by the time an Input Controller is assembled, a saving of about ½ in manufacturing cost has been achieved.

After the small amount of necessary machining has been done, and prior to assembly, the die cast parts are thoroughly degreased and given a chemical conversion coating of Iridite 14, followed by a black air-drying enamel.

The model 305 single cycle timer is a matching unit in size and general surface appearance to the Input Controller. It uses one aluminum and one brass for major structural parts.

In this timer, there has been a progression from sand casting through investment casting to die casting as a means of manufacture. With sand casting being the most expensive, aluminum die castings at the same stage of completion represent only 40% as great an investment, and the same part as an investment casting represents 60% of the cost of the sand casting.

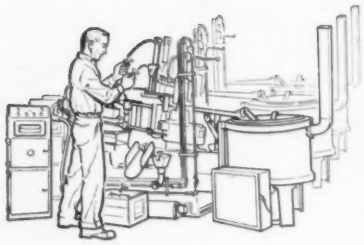
The machining operations on the castings used in this timer are simple: tapping and reaming of the center hole and shaft hole.

Because of the low operational speed (maximum 16 rpm) and the very low load, aluminum may be

continued on page 107

total automation*

comes to die casting
with the continuously recycling



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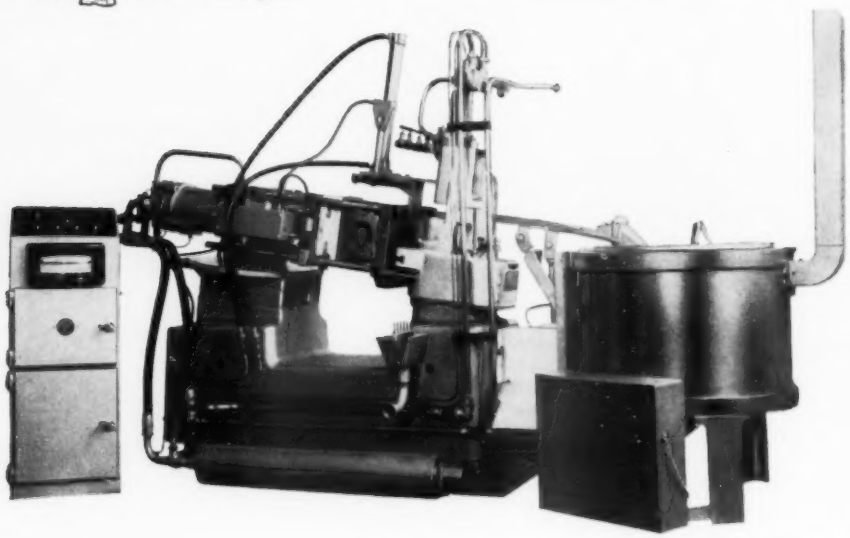

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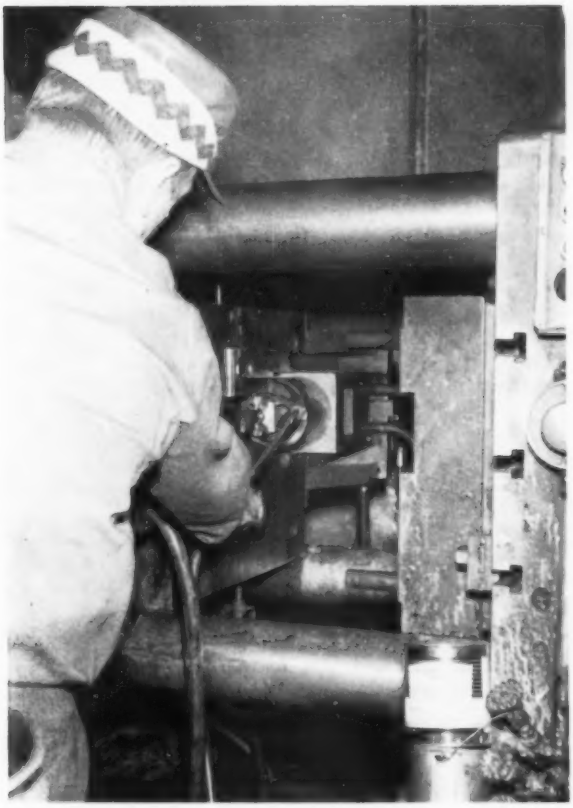


SPRAY APPLICATION of die lubricants is common. The use of swabs is slower and less uniform.

PLUNGER LUBRICATION is generally a hand operation with a brush. Some machines are equipped with automatic lubricating.

Die Casting Lubricants, Their Purpose and Use

by R. D. BLACK*

Here is expert opinion

THE purpose of die casting lubricants is to prevent the casting from adhering to the die and thus aid in producing a smoother, better finished product. A correctly chosen lubricant will permit the metal to flow into and completely fill cavities that cannot be filled otherwise.

In choosing the correct lubricant it is important to bear in mind the temperature of the metal being poured, the operating temperature of the die, and the alloy to be cast. It is impossible to select a lubricant that will perform equally well on both zinc and aluminum. At the same time, a lubricant that works well on aluminum when the die temperature is 300° F will not work well at 500° F.

When the molten metal comes in contact with the lubricant, the surface of the lubricant turns to a carbonaceous residue. This carbonaceous powder remains on the surface of the casting when taken out of the machine. Any residue on the die can readily be removed with an air jet.

Since there are many petroleum oils available and each forms a

continued on next page

*Sales Manager, The Rex Oil and Chemical Company, Cleveland, Ohio

LUBRICANTS

continued from preceding page

different amount of residue at different temperatures, it takes years of experience and research to select the proper blend of petroleum oil for specific operating conditions and temperatures.

If the lubricant has the correct fire point enough of it will remain on the die in a liquid state to allow at least five or six shots before another application is necessary. When the carbonizing temperature of the lubricant is too high, the lubricant will be absorbed into the surface of the casting and appear as an oil stain. When the carbonizing temperature is too low, the entire amount of the lubricant will be used on the first shot. The proper lubricant must carbonize but form a minimum amount of gas in doing so. In other words, it must not actually burn.

Soluble Oil Lubricant

A soluble oil or water soluble paste eliminates the smoke disadvantage usually prevalent with kerosene diluted lubricants. When soluble oil is mixed at a greater proportion than four parts of water to one part of oil, the quick chilling of the die from the water will cause the development of minute checks in the die and greatly shorten the die life. While soluble oil is an excellent lubricant, more supervision is required, and the operator's education is of the utmost importance.

One of the largest manufacturers of automotive grills is using this soluble oil type compound on a central system connected directly to each machine. Their die life is very good, and their percentage of rejects is abnormally low. By keeping their mixture to four parts water to one part soluble oil, they have had no trouble with die checking.

Boron Nitride Lubrication

Boron nitride is one of the newest type die coatings. The tests to date have indicated that an unusually large number of shots can be made with only one application of lubricant. Some die casters claim up to 500 shots per coating while others claim as many as 2000.

The greatest disadvantage of this material is that in most cases the die must be removed from the machine and heated before application of the lubricant can be made. The cost of application often times renders this material impractical.

ALUMINUM LUBRICANTS

There are also three popular types of lubricants most often used with the die casting of aluminum: Aluminum pigmented compound, waxes, oil blends, and graphite; and the mixture of stock oil and colloidal graphite.

Aluminum Pigmented Compound

The aluminum pigmented compounds are a mixture of pigment aluminum and stock oil, and they have proven to be one of the most successful compounds in use. Any operator can make good castings with this type compound. Over application does not necessarily mean rejected castings.

The aluminum pigment used has a much higher melting point than the metal being cast and will imbed itself in the surface of the casting. The stock oil provides the carbonaceous deposit which allows easy ejection. In many cases where a die is worn or checked or has

PICTURED ABOVE IS OUR MODERN SHOP AND OFFICES
exclusively devoted to engineering and building die casting dies and molds to exacting specifications. This plant was designed with capacities to handle and fabricate anything from a unit die insert to a 15 ton cylinder or grille die with the necessary skills and experience to save you time and money on your next tool.

RICHARD O. SCHULZ CO.
ELMWOOD PARK, ILLINOIS
●
DIE CASTING DIES • PLASTIC INJECTION AND COMPRESSION MOLDS

For more information circle No. 92 on the Reader Service Card

little or no draft, a good non-stained casting can be obtained with this type of compound.

One of the main disadvantages of this material is that it will build on the dies and if not watched closely, dimensional accuracy will be lost. When this build-up does occur, the dies may be cleaned easily on the machine using a caustic solution.

Waxes, Oil Blends, and Graphite

This compound works best on dies that are running from cool to normal temperatures. In this type compound, the waxes act as the wetting agent, and the oil and graphite are the parting agents. It is usually mixed with kerosene in a ratio of about fifteen parts kerosene to one part lubricant and then sprayed on the die.

The disadvantage is that the graphite has a tendency to settle and agitation at regular intervals is required.

Stock Oil & Colloidal Graphite

A lubricant usually used where the die temperature ranges from normal to hot. The carbonizing takes place slowly with this type of compound and if the dies are not hot enough, oil stains will show on the surface of the casting.

ZINC LUBRICANTS

At present there are three basic types of lubricants being used in the die casting of zinc. The most common is a combination of low viscosity index oil, fat, and colloidal graphite. Sometimes a water soluble oil or a boron nitride coating or both are used.

Low Viscosity Index Oil, Fat, and Colloidal Graphite Lubricant

A low viscosity index oil is used because it thins readily in the presence of heat. The fat is used as a wetting agent to break the surface tension of the oil allowing it to thin out and cover the entire surface of the die with a uniform thickness film.

Colloidal graphite is an electric furnace graphite which is about 99% pure. The particles of graphite range in size from 1 to 10 microns in diameter and will not stick together or build on top of each other. This man-made graphite is far superior to flake or mined graphite which is about twenty times the size of colloidal particles and which contains far more impurities. Impurities will cause the particles to bulid up on the die, changing the dimensions of the casting.

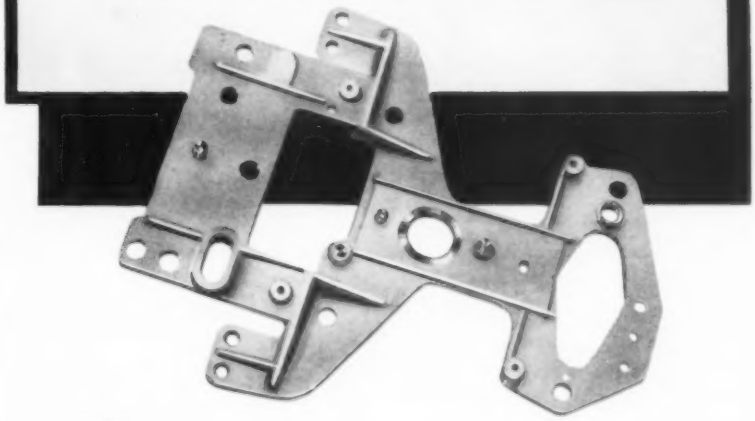
Graphite is used in a die casting lubricant to fill the pores of the die and to permit easy ejection of the casting. Each particle of graphite is like a tiny piece of coal or shale. These particles shear very easily and half of them remain on the die while the other half stays in the surface of the casting. Graphite, contrary to most beliefs, actually helps in the plating of castings because it is one of our best electrical conductors.

This lubricant may be applied as received with a swab or brush. However, it is usually diluted with kerosene and sprayed on the die.

When properly used this compound makes an excellent die lubricant, gives a beautiful hardware finish, and permits easy ejection from the cavity. Its chief disadvantage is the smoke from the kerosene when it is sprayed on the die. Over application causes staining of the casting.

SHORT RUN DIE CASTINGS IN ZINC PRODUCED THROUGH

MODERN Craftsmanship from Phoenix



We, at Phoenix, are not Swiss watch-makers, but we do pride ourselves on producing some of the most intricate, close tolerance zinc die castings made today for some of the most respected names in American industry. Coupling modern production facilities and techniques with a good measure of care and "pride in a job well done" has enabled us to build an enviable reputation as a prime supplier for short run, precision work. And the really tough jobs, with many extra operations, don't faze us a bit . . . as a matter of fact, we thrive on them! In addition, should you encounter a zinc die casting problem, our engineering department stands ready to give you the kind of able assistance you need to solve it. Next time you need the finest in zinc die castings . . . think of Phoenix!

PHOENIX DIE CASTING CO.
21 ILLINOIS STREET BUFFALO, NEW YORK

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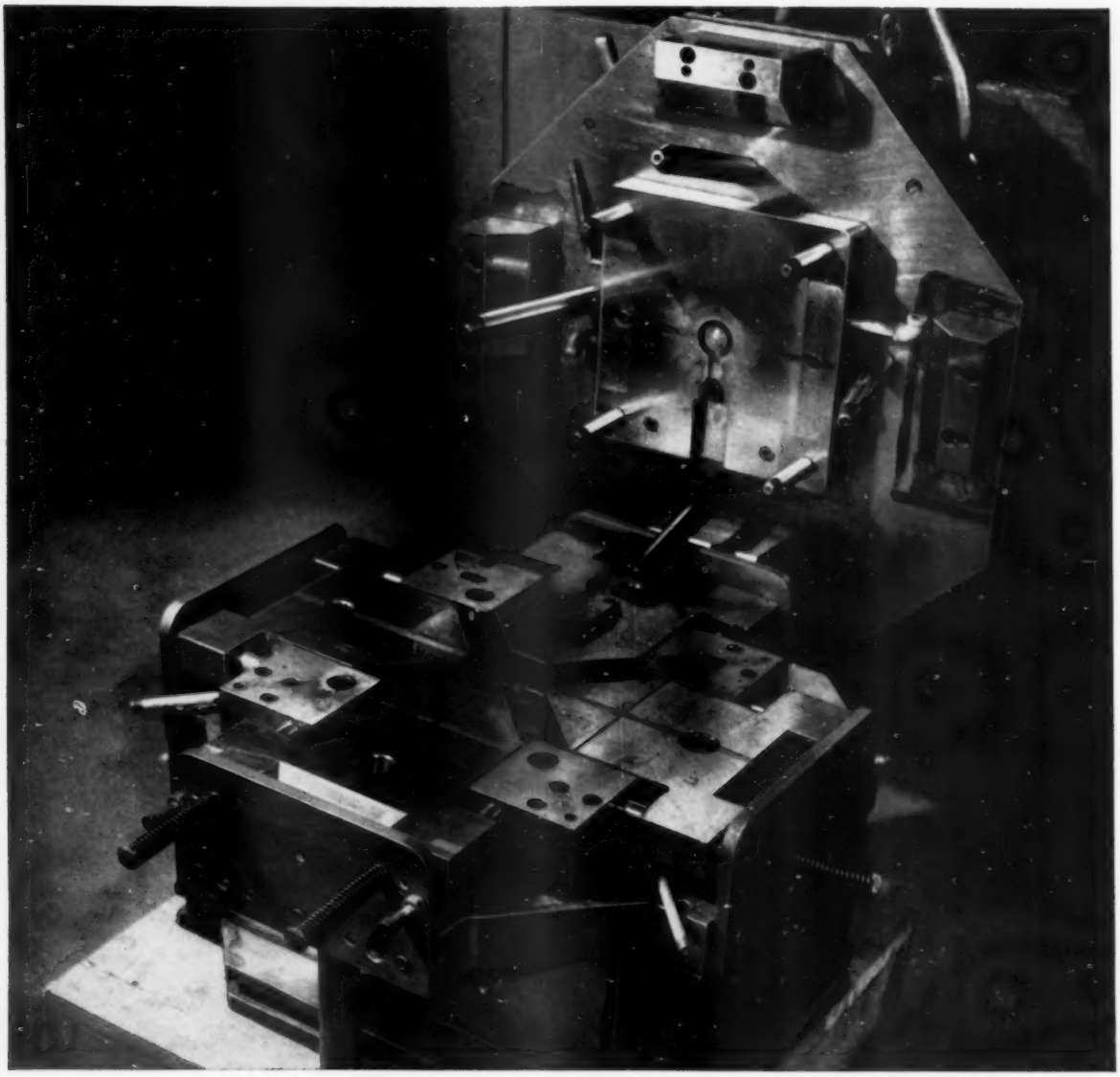

Cromo-High V for long-wearing dies

When you're die-casting lead, aluminum, or magnesium, you can be sure of long-wearing dies when you specify Cromo-High V. It's Bethlehem's 5 pct chrome-moly tool steel, containing 1 pct vanadium. Time and again, this popular grade has given outstanding performance on long-run jobs.

Cromo-High V is excellent for die-casting because of its stubborn resistance to wash and erosion. And it has plenty of toughness for those high-production jobs. Cromo-High V is made by a controlled melting procedure. It's a uniformly annealed steel, making it easy to machine. Moreover, it has good center density and grain refinement, and is free from porosity.

Cromo-High V is a uniformly deep-hardening steel, with minimum size change and warpage. Even in massive sections it can be heat-treated to a uniform hardness as high as Rockwell C 45-47.

Your Bethlehem tool steel distributor can furnish you with all the facts about Cromo-High V. Or better still, order enough for a few trial runs.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM TOOL STEELS

BETHLEHEM STEEL

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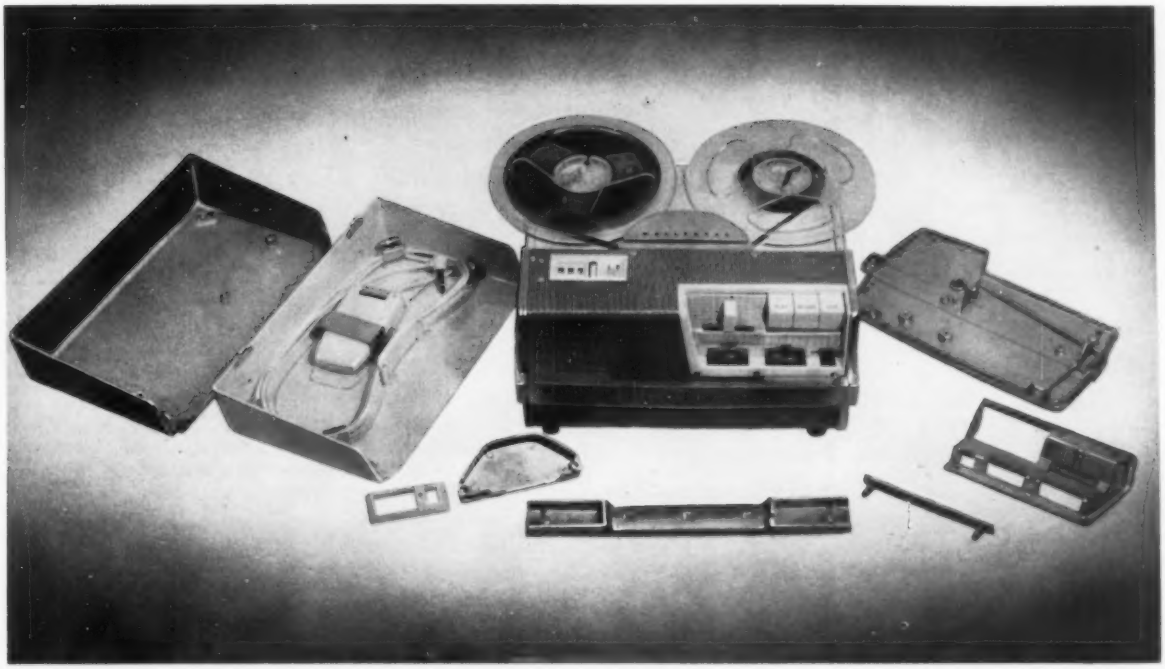


DIE CASTINGS used in the recorder, from left to right, are: case cover, counter bezel, recording head cover, handle, clean-out cover, key bezel, and side. They represent an excellent example of product re-design from "inside out". Engineers developed these castings after studying product production-needs in detail.

DIE CASTINGS

Designing From The Inside Out

WHEN the Wollensack Division of the Revere Camera Company, in Chicago, decided to produce a portable tape recorder for the home market, design engineers wanted, not only to produce a true high fidelity unit, but the smallest and lightest one as well.

Standard concepts of recorder design were discarded and the unit was built from the "inside out" . . . mechanism first, housing second.

The use of die castings made several design innovations possible: the sides of the recording unit form the sides of the case; the speaker grille is in front of the recording mechanism; all controls are centralized in one forward section; the recorder is styled around all-metal airplane type construction.

To produce a "quality look" in a small tape recorder, Revere and Wollensak designers specified die castings for eight visible parts—two side castings, recording head cover, clean-out cover, counter bezel, key bezel, handle, and top cover.

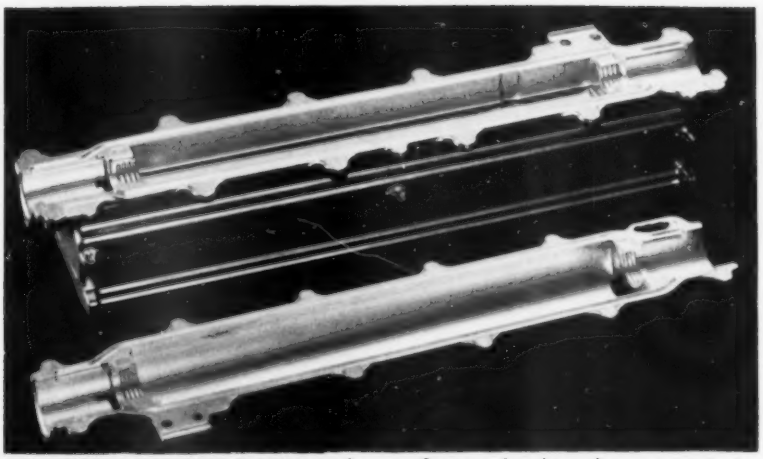
Other materials such as plastics were considered but rejected because only die casting assured the holding of close tolerances, high strength, and better appearance. Designing for cores, bosses, and engravings in the die castings, not only speeded production but reduced manufacturing costs.

Seven parts are die cast in aluminum and one in zinc by the Precision Castings Co., Division of the Harsco Corp., Chicago. The castings require little machining. Finishing consists of chrome plating or applying a baked enamel finish. Despite problems inherent in chrome plating of aluminum, Wollensak engineers decided that styling demanded this type of finish.

The surface of the castings for both plating and enameling therefore, had to be almost a "jewelry" finish, with close grain and complete homogeneity of metal in the castings.

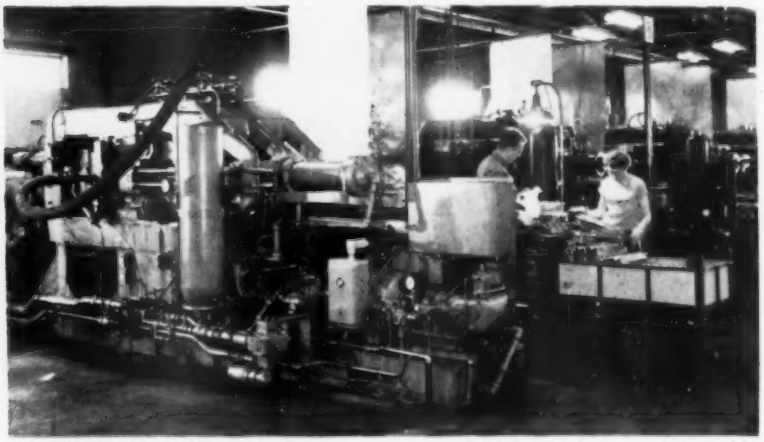
The two side castings are cast with a groove to simplify the masking. This not only reduces the cost of applying the finish, but allows closer fitting of parts. The top cover is finished in a range of baked enamel colors both inside and out. It is cast in a single impression die with bosses to which steel clips are attached to hold microphone and cord in place.

The counter bezel and key bezel are also painted while the recording head-cover, cleanout cover, and handle are chrome plated. The handle is made in a two-impression die with lettering depressed to permit filling with black enamel later.



100 PERCENT PRESSURE-TIGHT are the specifications for this splice-case. Only by vacuum die casting can this part be made with low rejects.

Here's how to go about planning the installation of . . .



AN OVERHEAD VACUUM LINE permits maximum flexibility without requiring additional floor-space. One line serves seven machines.

Charles W. Ohse

A Simplified, Low Cost,

By CHARLES W. OHSE*

THE idea of using vacuum to obtain better die castings is old. The practical application of vacuum in die casting is very new, it's been applied in only the last two years.

One of the newest systems is in use by The New England Die Casting Company. This method of applying vacuum to a die cavity was developed in our plant, the result of 36 years of intermittent experiments.

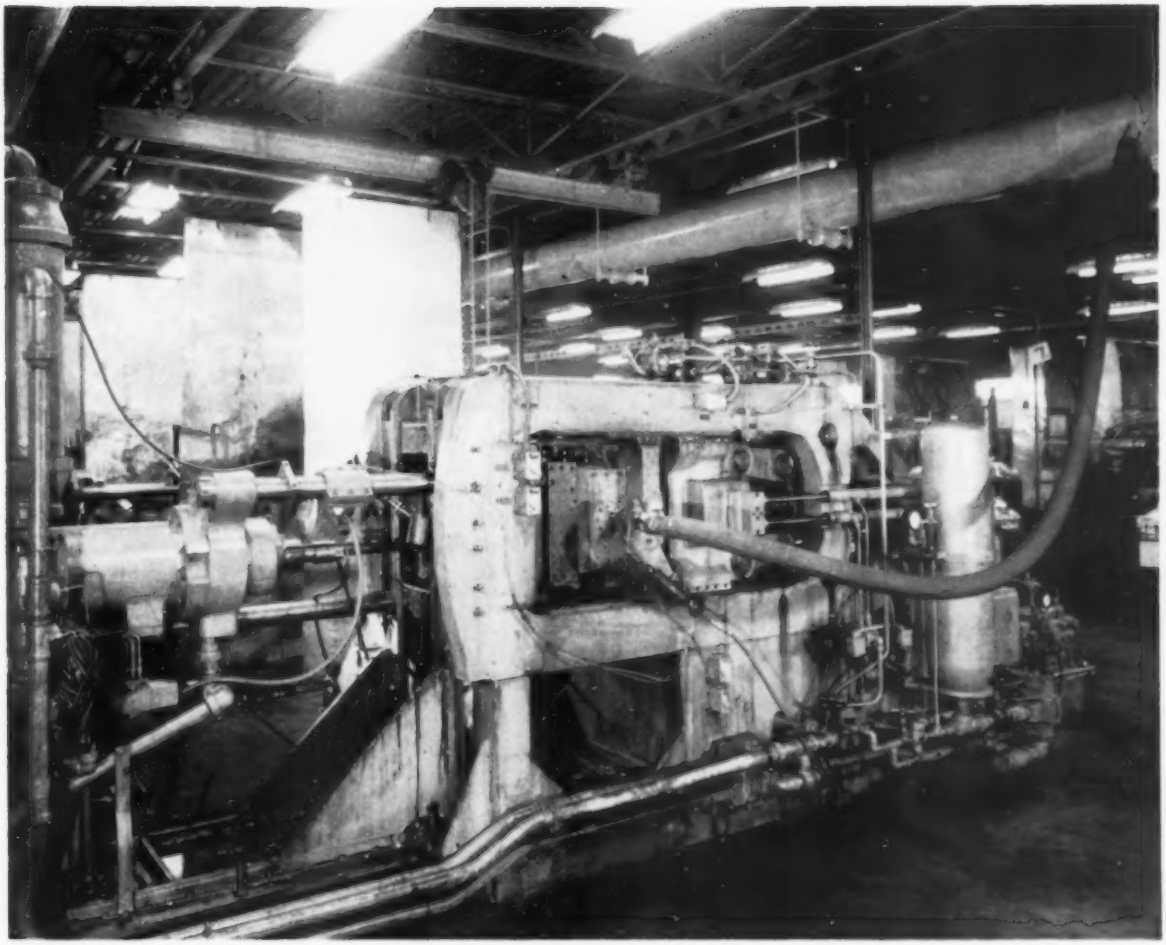
Before describing our vacuum system, let's discuss why we wanted it. Many of the jobs in our shop are difficult ones. We produce castings that must be pressure tight, parts with very thin walls, parts with long, small diameter projections, and similar die caster's problems.

Now in theory, at least, porosity is caused by gases trapped in the metal. This gas is compressed by the pressure of injection and by shrinkage as the metal cools. It is trapped air in the die cavity and metal chamber that increases the difficulty with thin walls and high bosses. The air cannot escape at all or cannot escape fast enough. If trapped air is the cause of faulty castings, the obvious answer is to remove the air before injecting the metal into the die.

There's another source of air trouble. When aluminum is poured into the shot sleeve it only partly fills the sleeve. As the plunger advances and seals off the pouring hole, the air in the shot sleeve is trapped and is forced into the die cavity with the metal as the plunger advances. By the time this air reaches the die cavity most of the vents and overflows are closed. The only place left for the air is the interior of the casting. It mixes with molten metal and causes internal porosity and stresses.

So we have very good reasons for wanting to get rid of the air in the

*President, The New England Die Casting Co.



SIMPLICITY without loss of clearance is essential for a successful vacuum die casting system. For best results, the dies must close and lock before the air pressure in the die cavity is reduced. This allows evacuation of cavity and shot sleeve.

Vacuum Die Casting System

die cavity and particularly the shot sleeve before injecting the aluminum into the die.

Now what is the best way to remove the air? The patent literature goes back many years and about every possible method of evacuating the die cavity has been suggested at least once. Many of the methods were extremely complicated and most of them quite expensive. This brings up that important point—cost. We have a considerable number of machines in our shop. If we were to convert all, or even most of them, to vacuum operation the conversion had to be inexpensive. Not only that, the conversion had to permit the use of existing dies with little modification and it could not interfere with normal operation of the machine or with installation or removal of dies.

We became convinced that the best and simplest way was to hook the vacuum line as direct to the die cavity as possible, to have the smallest possible volume to evacuate. Then if we used a very large volume system, the rate of air removal would be rapid. A comparatively small pump could be used as there would be ample time between shots to let the pump reduce the system pressure. Another desirable feature of this method is that the die is visibly closed, and locked, when the vacuum is applied (vacuum continues in effect during the whole injection cycle). The shot sleeve is sealed to atmosphere by advancing the plunger just enough to seal off the pouring hole after the molten metal has been put in.

So this is the system we developed:

On the die we machined a channel around the cavity. At several points in the channel we drilled holes into the ejector box or vacuum manifold. We also machined standard vents from the

continued on page 44

channel to the die cavity (.006" to .008" deep). These vents must have volume enough for the air in the cavity and shot sleeve to be removed quickly, but shallow enough so that any molten metal that enters the vent will freeze before it reaches the channel.

The die halves must seal at the parting line to prevent air leakage. We accomplish this with an asbestos gasket around the perimeter of the die.

Pressure is reduced with a vacuum pump hooked to a surge tank and then to the die cavity with steam hose. There is a solenoid operated air cylinder actuating a gate valve so that the vacuum system can be applied and shut off in proper sequence.

To seal off the pouring hole we modified the injection cycle. Metal is poured into the shot sleeve and the plunger then advances just enough to seal the pouring port. This occurs, of course, after the machine is closed and locked. When the pouring hole has been closed the valve on the ejector box opens (timer controlled) and the die cavity and shot sleeve are evacuated. The shot is then completed in the usual manner.

All gases should be evacuated before injection of the metal into the die starts and the vacuum must be kept on during full metal flow into the cavity. This removes air that may leak in and also gases and vapors that result from heating of the lubricant. This last point, the removal of gases and vapors caused by the lubricant is vitally important. But the proof of the pudding is in the eating; how does it work. For years we have been making a telephone terminal splice case. This case surrounds a cable splice and must withstand an internal pressure of 15 psi of nitrogen and be moisture tight.

Rejection rates on this part have always been high due to leakage under 30 lbs. air pressure. We rejected many castings in our plant and then the customer rejected more when machining produced leakers due to laminations in structure. This part is the one we selected to prove our vacuum die casting system. Without changes in the die other than to cut-in the exhaust channels and sealing the part lines and the ejector box, the casting is now made with about 2% rejects in our plant and no rejects at all by our customer. A startling improvement is shown by weighing the castings. Before vacuum was introduced the splice case casting after trimming weighed 2.54 pounds. After we started under a vacuum of 27" to 29" the weight of the trimmed casting increased to 2.70 pounds, a weight increase of 6.3%, entirely the result of denser structure and elimination of lamination. We have since applied this procedure on fourteen troublesome jobs with gratifying success in each instance, particularly with #218 alloy whose inherent sluggishness disappeared entirely.

There are a number of questions that we have been asked about this vacuum system. Does the use of vacuum influence casting speed? Generally no. Sometimes the cycle is a little faster. Can the system be used with dies we now have? Probably, but remember that improperly designed dies will not work, vacuum or no vacuum. Is

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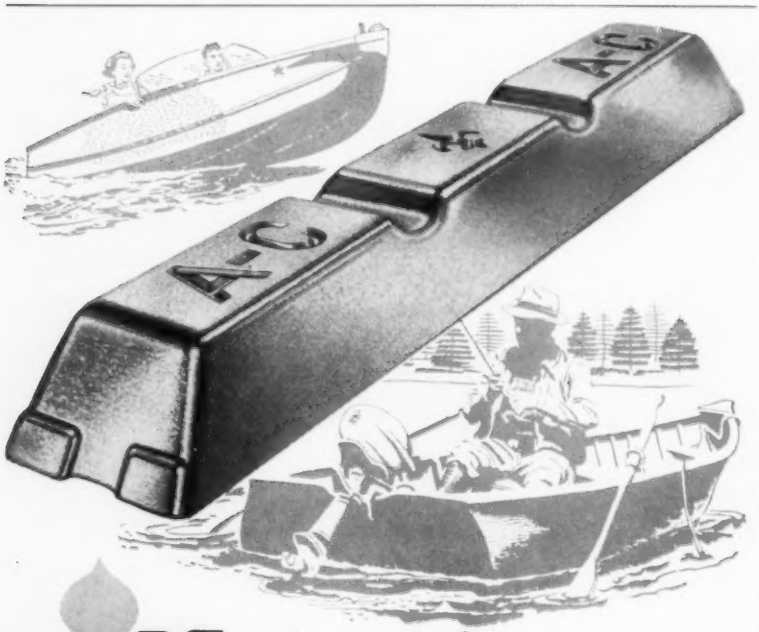

ACcent on quality

Over the waves skim light hearted boaters of today. And with it comes the need for more light, non-corrosive aluminum in outboard motors. Alloys & Chemicals is proud of the part AC aluminum alloys play in the boating industry . . . alloys that place the "ACcent on quality"!

That's why today more foundries and die casters rely on AC quality ingots to produce quality products.

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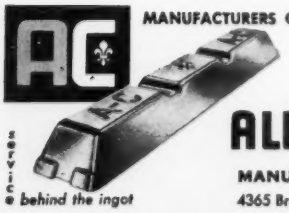

ALLOYS & CHEMICALS

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• behind the ingot

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there any effect on die life? We think dies may last longer, oxidation seems to be reduced. Is there any change in the metal or die temperature? No. Is there any change in the kind or amount of lubricant used? Generally no, though it may be possible to use less lubricant. Can a central vacuum system be used? Certainly. We have one which can handle at least seven machines. All of the machines are good sized, rated at from 600 to 800 tons locking pressure. Can our system be used on any type of cold chamber die casting machine? Yes, if timing, injection control and locking is obtainable. We have mostly Lester-Phoenix machines and are using these on our vacuum system. Can our system be adapted to automatic ladling? No interference apparent. What, roughly, is the cost? Using a central vacuum system that has a capacity of at least 25 times the total volume of cavities to be evacuated, it should not cost more than $2,000.00 per machine in multiples of three or more, plus the cost of modifying the casting cycle on the machine. Naturally this does not include the cost of modifying any dies.

NEW AND LARGER PLANT BUILT BY HOOVER TOOL & DIE CO.

Final installation of machinery and equipment marks the completion of the new Hoover Tool & Die Co. plant at 5775 E. 10 Mile Road, Centerline, Mich. John J. Paulus, president and general manager, announced.

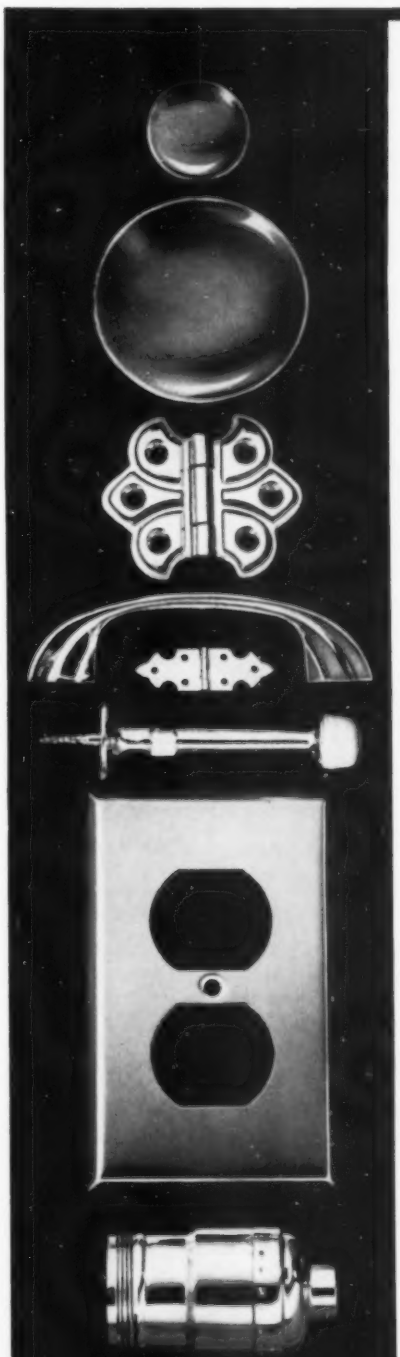
The new plant, located in the growing industrial area just northeast of Detroit, embodies 63,000 square feet, including 4,500 square feet for the Engineering Department and 5,000 sq. ft. of office space.

NATIONAL RESEARCH CORP. APPOINTS GENERAL MANAGER

James H. Moore has been named general manager of NRC Equipment Corporation, it was announced by Richard S. Morse, president of National Research Corporation, the parent company.

Also appointed to the management of the wholly owned subsidiary is Harry D. Stone of Akron, O., who becomes sales manager.

Moore will be responsible for development, production and sales of one of the country's largest lines of high vacuum equipment.



Why profits are bigger *when you plate with vacuum*

An investment in a CEC vacuum coater brings big returns three ways:

1. Lower labor costs. Operating a CEC vacuum coater takes no special skills. Labor costs per piece are far lower than in traditional methods because the process is *fast*.

2. Eliminate buffing and polishing. A CEC vacuum coater lays down a surface that's bright without polishing. No further handwork is needed—just an easily applied protective lacquer.

3. Lower material costs. Ten cents worth of aluminum will vacuum-plate thousands of parts such as those shown here. Lacquers are relatively inexpensive, too.

Added durability

The *decorative* values of vacuum-plated finishes are well known. Now they can be remarkably durable, too. New coatings—recently developed epoxy lacquers, synthetic resins—can preserve those gleaming finishes indefinitely against abrasion, humidity, and other hazards.

To learn more about this new, and highly profitable process, write us for bulletins.

CEC

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Rochester Division, Rochester 3, N.Y.

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KUX

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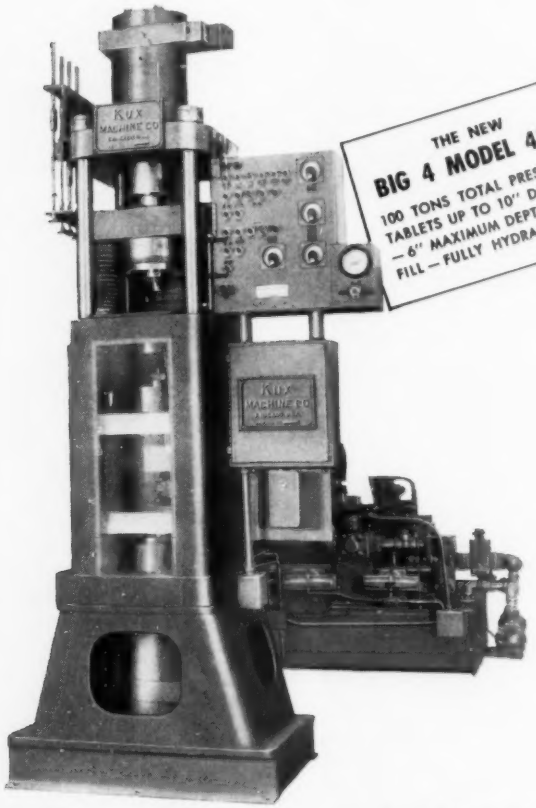
POWDER METAL PRESSES

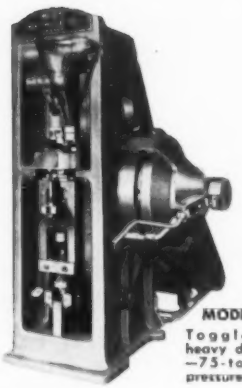
FROM 10 TONS TO 500 TONS • DIE FILLS UP TO 15"
HYDRAULIC OR MECHANICAL MODELS

An entire range of sizes and models, both mechanically and hydraulically operated is available in the Kux family of powder metal presses, a few of which are illustrated. A card will bring you an illustrated catalog of these famous machines which set the standards for peak performance.

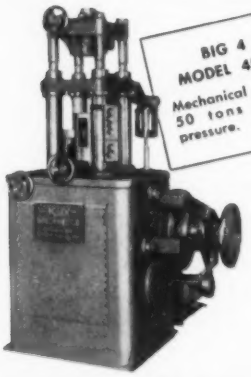


THE NEW
BIG 4 MODEL 4100
100 TONS TOTAL PRESSURE — TABLETS UP TO 10" DIAMETER — 6" MAXIMUM DEPTH OF DIE FILL — FULLY HYDRAULIC

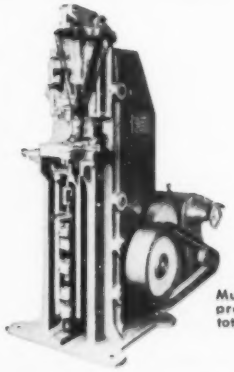
- **Fully Hydraulic** — applies pressure to tablet with both upper and lower punches. Lower punch ejects tablet with full forming pressure.
- **Completely Automatic** — pushbuttons operate machine continuously or through a single cycle with an automatic stop position.
- **Accurate Dimensional Thickness of Tablets** — upper and lower punches come to a positive mechanical stop position, holding thickness of each tablet.
- **Always True Density** — upper and lower punches can be adjusted to come to a hydraulic pressure stop position, applying exact pressure on the tablet to give true density regardless of variation in die fill.
- **Perfect Punch and Die Alignment** — combination leader-pin, ball-bearing guides keep upper punch in perfect alignment with die at all times, so that close tolerance parts can accurately be made.
- **Push Button Control of Adjustments** — for upper punch penetration into die, and the die fill allows instant and accurate change of either setting, and scales show the exact position of the punches at all times.
- **Independent Secondary Lower Punch Mechanism Available** — hydraulically operated with separate timing and stroke control — can be used to apply pressure, to eject compact, or to move core rod up and down during filling or ejection sequence.



MODEL 65B
Toggle type heavy duty press —75-ton total pressure.



BIG 4
MODEL 450B
Mechanical press 50 tons total pressure.



MODEL 64
Multiple motion press — 30 tons total pressure.

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KUX
MACHINE CO.
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Also builders of a full range of die casting machines . . . from 25 tons to 1000 tons in size.

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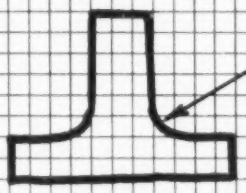
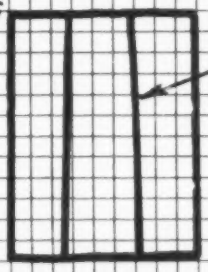
Cost Cutting Ideas for Sinterings

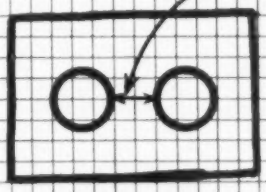
use these **Design Tips** for lower costs -better products



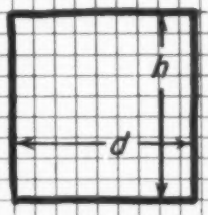
Allow a generous radius. Sharp corners cause stress concentrations.



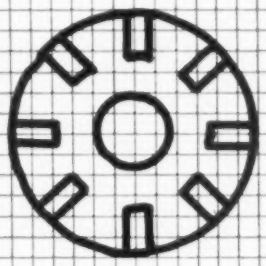
Allow a taper on cored holes if possible.



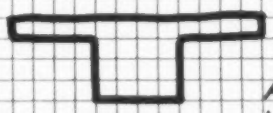
Allow adequate stock between cored holes. Not less than 1/4" to 1/2"



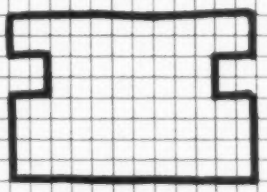
Ratio of height (h) to diameter (d) should not exceed 4:1.



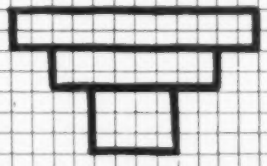
Narrow splines are difficult and expensive to mold.



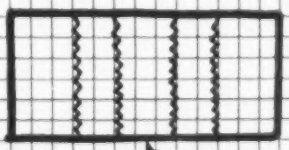
Avoid large thin flanges.



Undercuts are difficult to mold. They should be machined.



Multiple flanges may require special and expensive tooling. Machining smaller step may be cheaper.



Where frequent assembly and disassembly is likely, design for a threaded insert.

DATA OFFERED IN THIS MONTH'S ADS

the Reader Service Cards on the facing page will get you these free reference materials. Circle the numbers and mail.

1. **Zinc Die Casting Machine** — Hydraulically operated Model #5000 has 150 tons locking pressure and 15" x 15" clearance between tie bars, provides high speed production of quality castings. A.B.C. Die Casting Machine Co. offers detailed information.

2. **Casting Supplies**—Detailed information is available on Refrax Pots that retain heat, have less swelling and distortion, are tough and durable. ACF Industries.

5. **Induction Furnaces**—Equipment with capacities from a few ounces to several tons is described in literature available from Ajax Electrothermic Corporation.

8. **Die Casting Machines**—A line of low-cost, high-speed equipment is described and all specifications given in a folder offered by American Die Casting Machinery Co.

16. **Fluxes**—for all metal melting industries are presented in technical literature from Atlantic Chemicals & Metals Co.

19. **Die Casting Machines**—A complete catalog is available from B & T Machinery on their line of cold chamber and gooseneck type die casting machines designed and built to customer specifications.

20. **Hydraulic Compacting Press**—combines high tonnage capacity with multiple motions normally found only in small presses. Complete details and specifications are offered by Hamilton Div., Baldwin-Lima-Hamilton.

23. **Sintered Powder Parts**—Bunting Brass and Bronze Company offers catalogs and a 24 page engineering handbook of sintered powdered products, their composition, manufacture and application.

24. **Die Casting Machine**—Buhler Brothers, Inc., offers detailed technical information on their Type GPF, which develops 800 tons of locking force, 60 tons of injection force.

25. **Sintered Steel Parts**—An informative folder on "Quali-Sint" low-cost, high-strength parts is available from Burgess-Norton Mfg. Co.

27. **Die Casting Machines**—Eight die casting machine models with a variety of "bonus" features are described in a catalog from Cast-Master, Inc.

29. **Die Casting Machines**—Bulletin 5246 from Cleveland Automatic Machine Co. gives specifications of 50, 200, 400 and 600 ton machines for zinc and aluminum die casting.

30. **Die Grinding**—Brochure describes capabilities of "Visual Grind" in construction of precision high-production dies, dies for powder metallurgy, lamination dies and special purpose dies.

31. **Vacuum Plating**—Bulletins from Consolidated Electrodynamics, Rochester Div., tell how the process lowers material and labor costs, eliminates buffing and polishing.

33. **Design Engineering Show**—Show tickets and information on ASME Conference registration are available.

35. **Sprue Bushings**—sprue spreaders, hot form and nitralloy ejector pins and cavity retainer sets are described in literature from Detroit Mold Engineering Co. Complete prices and specifications are included.

39. **Sintering Furnaces**—Bulletin No. 461 shows typical installations of EF gas-fired, oil-fired and electric furnaces. The Electric Furnace Co.

44. **Metal Powders**—including the newest cermets are covered in a complete reference manual now available from Charles Hardy, Inc.

46. **Alloy Selection**—is explained in two booklets from Henning Bros. & Smith, Inc. A reference book and guide gives complete engineering data on properties and applications of Zamak (zinc base) alloys. A technical guide explains factors influencing the production of sound castings.

48. **Sintering Furnaces**—for controlled atmosphere or vacuum sintering are described in bulletins 357 and 557 from the Hevi-Duty Electric Furnace Co. Technical information is provided to help determine the best furnace for individual sintering requirements.

49. **Investment Casting**—A brochure from Hitchiner Mfg. Co. shows how investment casting answers design problems in shape, detail, production and material.

52. **Die Casting Machines**—Bulletin 5400J from Hydraulic Press Mfg. Co. presents information on how their machines provide quality castings, better density control, uniform finishes and less scrap.

53. **Sintering Furnaces**—for research, pilot production, quantity production and specialty sintering are described in free technical literature. C. I. Hayes, Inc.

54. **Melting Furnaces**—Inductotherm Corporation's Bulletin 70 tells how "Inducto" high-frequency induction furnaces give extra castings per day with consistently high quality.

58. **Electric Furnaces**—Technical information is available on rocking electric furnaces for small quantities of any ferrous or non-ferrous alloy. Detroit Electric Furnace Div., Kuhlman Electric Co. produces the equipment, which gives homogeneous alloying and full heat utilization.

59. **Powder Metal Presses**—A complete line of hydraulic and mechanical models in capacities from 10 tons to 500 tons is presented in an illustrated catalog from Kux Machine Co.

61. **Induction Heating**—36 illustrated pages, in the new Lepel High Frequency Laboratories, Inc. catalog give valuable information on a complete line of induction heating equipment.

73. **Metal Powders**—Technical data is available on Grade A-213 and Grade B-280 Plast-Iron powders. Plastic Metals Div., National-U. S. Radiator Corp.

77. **Brass Powder Metallurgy**—"Facts about Pressed Brass and other nonferrous Powder Parts" is the title of a booklet for evaluating the method in terms of particular needs. Published by The New Jersey Zinc Company.

90. **Sinterings**—A new brochure, "How to Cut Precision Parts Costs with the Remet Powdered Metal Process", is available from Reese Metal Products Corp.

91. **Cavity Blocks**—Literature and prices are available on Master-Mold cavity blocks that cut die costs, reduce set up time, save storage space and make short runs profitable. Richards Tool & Mold Co.

94. **Powder Metal**—presses feature independent press adjustments and direct-reading calibrations for easy set-up and control. Data is available from F. J. Stokes Corporation.

continued on page 57

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- ☐ Plaster Mold Castings
- ☐ Shell Mold Castings
- ☐ None of these

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5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295
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9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298
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14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306

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4	21	38	55	72	89	106	123	140	157	174	191	208	225	242	259	276	293
5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305
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PMM Finishing Section

The specialized finishing methods, equipment and materials used to machine, assemble, surface condition or surface coat precision metal molded parts are presented here. This includes all secondary operations which convert a raw casting to a finished product.

Barrel finishing provides maximum uniformity and economy.
See page 51

Introducing Allied's

IRILAC™ #1000

New Clear Protective Coating for All Metals . . . as safe and easy to handle as Water!

New method of protection incorporates corrosion inhibitors in a water-soluble polymer base. Dries to an extremely thin, tough, durable coating—clear in color. Does not chemically affect base metal or any post-treatments. Used as a protective treatment alone or to enhance value of post-treatments.

Allied's new Irilac #1000 is a concentrated solution of a water-soluble polymer with built-in complex corrosion inhibiting materials. It was developed to answer the needs of the metalworking industry for a non-conversion process that will provide corrosion resistance and resistance to fingerprinting and abrasion on base metals and electrochemically or chemically finished surfaces—without changing the appearance of the metallic surface.

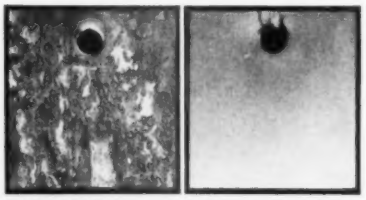
There are no hazards involved—Irilac is non-fuming, non-toxic, and requires no special fire prevention measures.

THE PROCESS

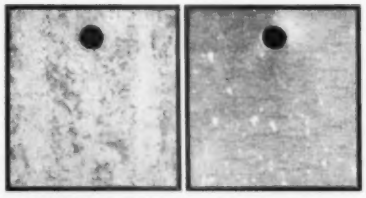
Irilac #1000 is diluted with water to provide a simple one-pass working solution. It is then applied by dip, brush or spray and forms a coating that quickly *bonds* to the metal surface without reacting with the surface.

THE PROPERTIES

The resulting coating is clear, transparent, thin yet durable. It has excellent water-resistant properties, and can be rubbed, handled and subjected to rough treatment. The surface to which Irilac has been applied is not altered—in fact, the transparent coating brings full tone to colored surfaces and clarity to iridescent surfaces. The water-thin physical characteristic of the solution means that the coating provides protection in recessed areas that are difficult, if not impossible, to protect with other methods.



STEEL PANELS: bare (left) and coated with Irilac (right) after 8-hour salt spray.



ALUMINUM PANELS: bare (left) and coated with Irilac (right) after 168-hour salt spray.

WHERE IRILAC CAN BE USED

Irilac #1000 can be applied to *any* metal—wet or dry—treated or untreated. All metals can be processed in *one* operation in the same solution. It can be applied in conjunction with any process—over Iridite, anodized, phosphated surfaces, black oxide, etc. Surfaces treated with Irilac provide a good base for paint.

APPLICATION ADVANTAGES

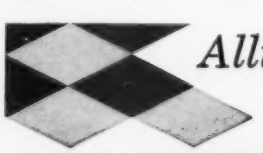
No other process or material available for the protection of metals offers all the application advantages found in new Irilac #1000:

1. It can be applied to any clean metal simply by dip, brush or spray. No special equipment is required.
2. Saves time—just apply and dry—no reaction time required.
3. No hazards involved—no exhaust or special fire protection equipment is required. Irilac is non-fuming and non-toxic.
4. Saves space. Presents no disposal problem. Low in first and final costs.

Because of its versatility and complete safety, Irilac has unlimited uses. For example, it will protect aluminum furniture, brass hardware and fixtures, steel parts of all types, zinc castings, etc. In fact, any base metal or plated surface, or those treated with electrolytic or chemical post-treatments, can be improved or enhanced with Irilac.

IRILAC #1000 MAY BE THE ANSWER TO YOUR PROTECTION PROBLEM

Our development staff will be glad to work with you to determine the significant benefits Irilac can offer you. Simply send us some parts and let us show you what Irilac can do. No obligation, of course.



Allied Research Products, Inc.

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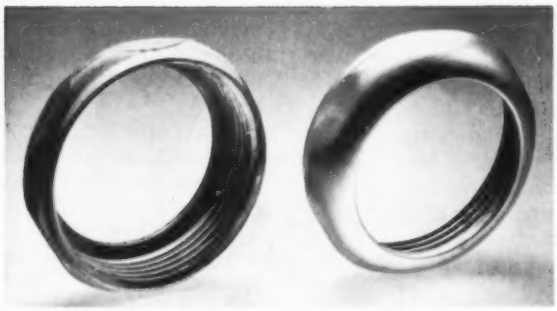
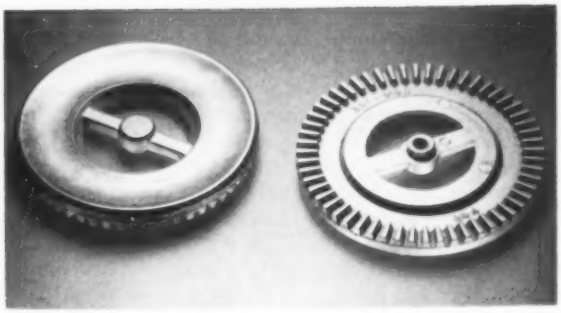




READY FOR PLATING or assembly. The castings shown in these two views can be plated after removal from the barrel or, if they are aluminum, may go directly to assembly. All fins, flash, and parting lines have been removed, the sharp corners given a minute radius and the entire surface uniformly polished.

Finishing Die Castings

Part III - Barrel Finishing

By Robert E. Earl*

THE first article of this series (1) dealt with the influence of design upon surface finishing of die castings. Barrel finishers have long been aware that design factors play an important part in determining whether a casting can be economically barrel finished.

The point stressed in the first article that "mass produced items must be mass finished" cannot be over emphasized. The barrel finishing industry has grown because of its ability to meet the various demands for surface finishing at greatly reduced costs.

A large portion of this growth in the barrel finishing industry has been directly dependent upon the adaptability of this finishing technique to the surface finishing of castings.

The advantages of barrel finishing are primarily: low cost, and uniformity of the final surface. The economy of barrel finishing is such that, with proper methods, cost reductions as high as 80% over hand methods are possible.

The die castings shown above are examples. Parts are finished at the rate of 400 pieces per hour in a 13 cubic foot barrel. Direct labor costs are 1/6 man hours and all other costs amount to only about $0.80 per load of 400 pieces.

These costs would be completely impossible to meet with hand finishing methods. Another great advantage of barrel finishing parts such as this handle is uniformity of finish. Because the polishing action in a barrel is entirely random it is completely uniform. With hand finishing operations such uniformity can not be secured.

Another outstanding advantage of barrel finishing over other methods is reproducibility from load to load. As long as the charge of parts, media, compound, and water are held constant and the speed of rotation and time of finishing are the same, the finish secured will be constant. This is true whether the parts are run in consecutive loads or spaced days, weeks or months apart.

All five of the accepted classes of surface finishes on die castings can be secured by one or another of the barrel techniques.

First Class or Hardware Finish

The major problem in achieving this finish is loading and unloading the barrel. The removal of the light surface oxide film is simple. A short cycle can be used with processed natural media and a mild polishing compound. Care must be exercised in both loading and unloading to prevent impingement.

The castings should be loaded in layers to disperse them throughout the media before starting.

During unloading, a canvas or plastic boot must be used to funnel the mass of castings and media onto a rubber or plastic coated separating screen. With this careful handling, blemish-free surfaces can be produced.

The processing cycle is short and, if proper speeds are selected, the parts will not strike each other during finishing. While production of this finish requires more labor because of the careful handling required, substantial economies over hand finishing are still possible.

Second Class, Secondary Plating Finish.

Generally this class of finish re-

*Technical Director
Roto-Finish Co.

quires a multiple step cycle. First a mild grinding compound and natural media to scour the surface and remove imperfections are used. This will produce a slightly matte finish without penetrating through the chilled skin of the casting.

The second step is burnishing. One method of achieving this is the Britehoning process. A natural chip with a compound designed to create an insoluble coating on the chip surface is used.

The coating eliminates all abrading action of the media to give only a gentle burnishing action on the matte surface. A smooth, clean, semi-bright surface is produced which can readily be plated, using a bright nickel process.

Third Class Finish.

This finish presents no problems to the barrel finisher. A single operation using a mild, siliceous abrasive is all that is required. During the cycle, the media deteriorates and changes from a mild abrasive to a non-abrasive slurry so that a soft matte finish is created. This finish is highly desirable for paint adhesion since it gives good "tooth".

Fourth Class: Paint Finish.

This is another finish easily secured in a barrel. Generally, a manufactured media and a harsher abrasive compound are used. A short cycle generally produces a matte surface which will cover gross surface imperfections and provide for paint adhesion.

Fifth Class: Mechanical Finish

This finish is also obtained with little trouble in barrel finishing. The media, compound and cycle are about the same as for a fourth class finish.

There are many cases where barrel finishing has been used for stress relieving large castings. This is done by the peening action of the chips on the metal surface. Good results are secured due to the random action in a barrel that gives a uniform, over-all surface action.

Care must be taken in finishing castings that have been machined before barrel finishing. They should be processed in natural media with a non-abrasive compound to prevent any of the abrasive lodging in blind holes or threads.

Also, if a casting is to be machined after barrel finishing, the processing should not include an abrasive compound because the abrasive may lodge in holes or areas to be machined and cause excessive wear on tools.

In selecting a barrel finishing process, there are many variables to evaluate. Type of metal, size and shape of the parts, condition of the raw casting, and the final surface required must all be considered. Each part must be considered as a separate case since the processing for one part is rarely adaptable to other parts.

The shape most adaptable to barrel finishing is a sphere, but any radiused part may be easily processed by careful selection of media and compound.

The most difficult part to finish in a barrel is a cube because the greatest abrasive action will occur at the corners. The tendency will be to reduce the cube to a sphere. The designer should, therefore, always design away from sharp corners and recessed areas.

The condition of the castings as received in a barrel finishing department is of great importance in selecting the sequence of operations. If the casting is top quality with no noticeable parting line, burrs, or chill marks, the operation is quite simple to provide a smooth clean surface suitable for plating or painting.

When there are heavy flash or parting lines, the finishing is more difficult. Generally these castings require two or more steps to produce an acceptable surface finish.

The selection of media for processing castings must be made on an individual basis and can be guided only by experience. The choice will depend on the condition of the casting, the size of the casting, the size and depth of cored holes and other factors.

A small chip usually gives a better finish, but the chip-size must be determined by the possibility of lodging and by separation problems. Larger chip sizes may cut faster, but will often give an inferior finish.

Compounds used in barrel finishing are roughly divided into five groups: abrasive, deburring, cut and color, coloring, and polishing. In each group there are specific compounds for each type of metal and for the kind and amount of work to be done.

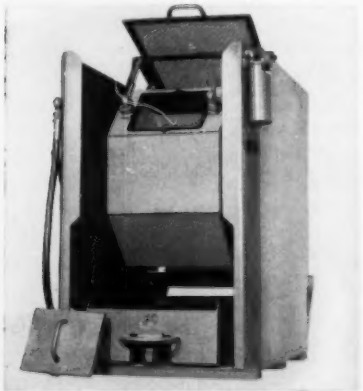
A further function of some compounds is pH control of the liquid in the barrel. For example either very high or very low pH can ruin aluminum and zinc castings. Further, the compound must be selected that is entirely compatible with the media to be used.

While barrel finishing is not a panacea for finishing die castings, it has solved many tough surface finishing problems and is capable of solving many more than are presently recognized.

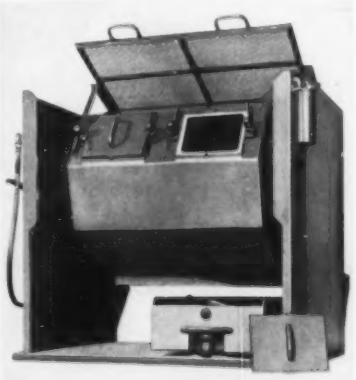
Without exception, barrel finishing offers the lowest cost method of surface finishing die castings when properly applied. When possible the initial design of die cast parts should contemplate this method so that most economical finishing methods can be employed.

(1) "Finishing Die Castings, Part 1—The influence of part and die design." PRECISION METAL MOLDING, Feb., 1958, pg. 43.

A SINGLE COMPARTMENT barrel. Machines of this type vary in size from small, laboratory or semi-production units to giants that can make hundreds of pounds of castings per charge.



A DOUBLE COMPARTMENT barrel. This is one of the most commonly used types since it allows a much wider latitude in processing and will handle smaller charges per compartment.



FIBER METALLURGY

continued from page 26

metal fiber at the present time is from metal wools. Steel wool, for example, can be obtained for as little at 29¢ per pound. Wools of rarer alloys such at titanium or molybdenum, for example, are not now available and fibers must be made from wire.

Wools can be prepared from nearly any machinable alloy and would be available if a sufficient demand developed. New sources may develop for metal fibers spun directly from liquid metal. Such fibers should be very much cheaper than those now available.

Both the American Viscose Company and the S.O.S. Company of Chicago, a division of the General Foods Corporation, have entered into licensing agreements with the Armour Research Foundation and are preparing to commercialize fiber metallurgy. The S.O.S. Company is completing the installation of a pilot plant facility for the production of fiber metal sheets and shapes.

III. APPLICATIONS FOR POROUS FIBER METAL MATERIALS

One of the most obvious applications for a porous metal material is as a filter. Tests of both liquid and gas permeability show that even for relatively dense, small pore size materials the pressure drop is low for practical flow rates. Figure 3 presents typical permeability data for several metal fiber filter materials.

Tests have also demonstrated that fiber metal filters have practically no tendency to discharge metal particles or fibers into the downstream side and that they show considerable resistance to mechanical failure. Figure 4 shows a plot of tensile strength versus density for several metal fiber materials.

The very high porosities possible for metal bodies having good strength suggest a host of additional applications. For example, such metallic bodies have considerably different thermal characteristics than dense materials. This property led to a preliminary test program to determine the resistance of metal fiber bodies to damage and penetration by direct application of a high-temperature flame.

A stainless steel fiber plate and a nonporous stainless plate of about the same weight per area were in turn exposed to identical applications of an oxygen-acetylene flame. The nonporous plate was burned through in about twenty seconds whereas the fiber material exhibited only surface damage after a three-minute exposure. This preliminary test suggests many thermal barrier applications.

Other potential applications for porous fiber metal materials which are being investigated are in the fields of transpiration cooling and boundary layer control. Porous fiber metal bodies appear to have a considerable capacity to damp mechanical and acoustical vibrations and will find uses based on this property.

IV. FIBER METAL BASE COMPOSITE MATERIALS

A. Fiber metal reinforced plastics can be made simply by impregnating porous sintered felts with resins or by techniques similar to those for making fiber glass reinforced plastics. These products now

continued on page 58

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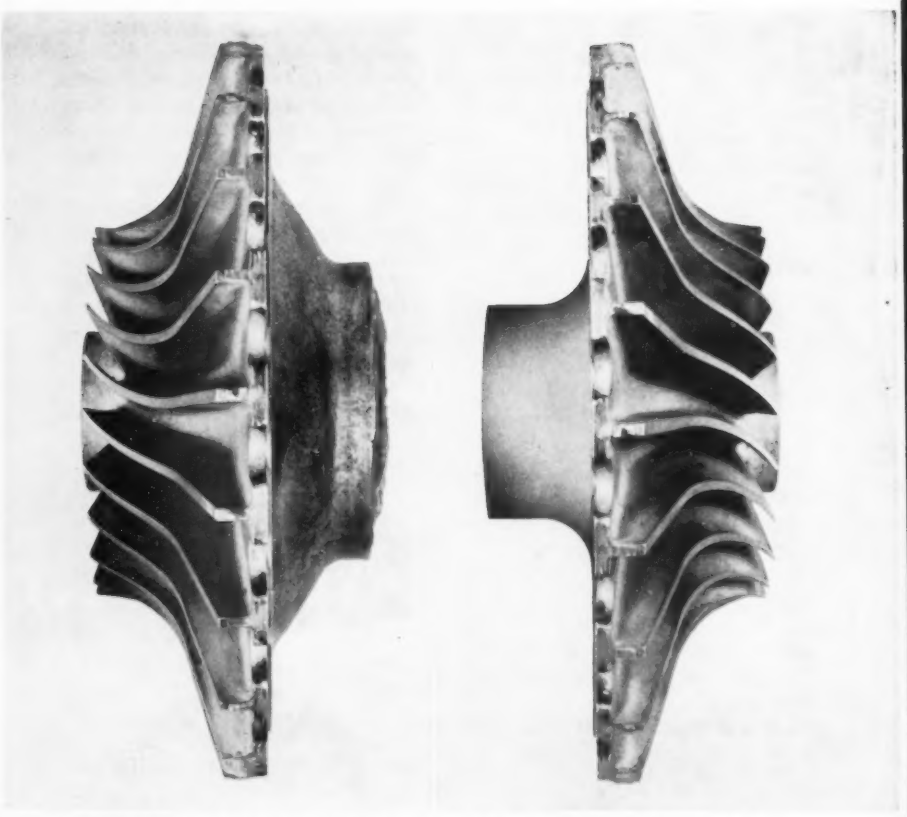
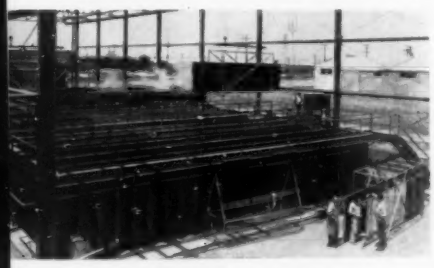


2. BEFORE milling, shaft of investment cast carbon steel impeller is wide.

3. AFTER chemical milling, shaft is reduced to the desired dimensions.



1. BATTERY of etch-tanks 50 feet long.

Use Chemical Milling to make Light, Close-Tolerance Parts

By **CHARLES H. LUNDQUIST***

A MILLING technique for castings has been developed in the past few months that is as versatile and independent of form as the casting art itself. Known as chemical milling, the new technique has been proving itself for several years in the shaping and contouring of aluminum, magnesium, titanium and steel sheets, rods, tubes and forgings. New methods have now been developed to apply the same technique to castings.

The chemical milling technique has immediate benefits for both the casting designer and the foundryman. Since chemical milling acts on any desired surface, no matter what its shape or location, the designer initially can calculate the structural requirements for a finished part, and then add the necessary metal to make it a good, sound casting. The foundryman, on the other hand, no longer has to compromise between good foundry practice and the desire to produce the lightest, strongest part possible.

*President, United States Chemical Milling Corporation, Manhattan Beach, California

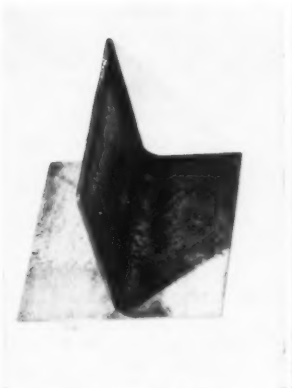
TABLE I
Comparison of Physical Properties Before and After Chemical Milling

BEFORE		AFTER
.185 inch	GAUGE	.062 inch
69.8 grams	WEIGHT	22.4 grams
260 RMS (max.)	SURFACE FINISH	180 RMS (max.)
Zero inches	CORNER RADIUS	.234 inch

Chemical milling readily adapts itself to mass production. A machine tool generally can handle only one part at a time, and perform only one operation at a time. Chemical milling, by contrast, takes place coincidently on all exposed surfaces, and the only limitation on the number of pieces that can be milled at one time is the size of the chemical milling tanks and supporting facilities.

HOW IT WORKS

Close control of the chemical action makes the process a valuable production tool. The action can be controlled to tolerances of ±.003 inch in addition to original surface tolerances on most production runs, and it works at the microscopic level. That is, the

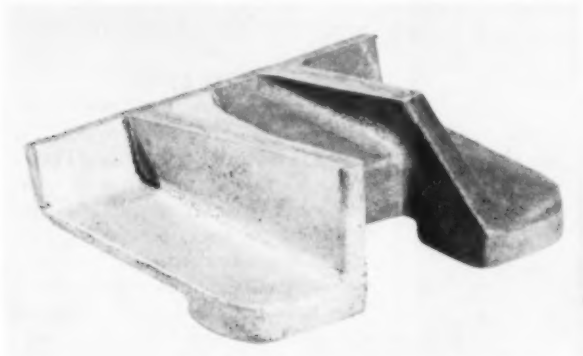


4. PERMANENT mold T-section it etched .05" on top.

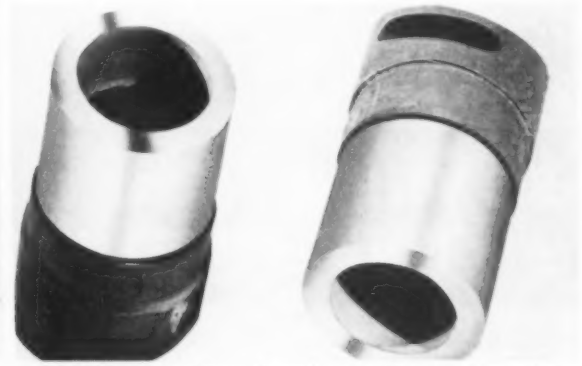
5. MAGNESIUM part is chemically milled .123".

(Part-dimensions before and after chemical milling given in Table I)

6. MAGNESIUM permanent mold casting had thick section chemically milled on left portion. Surface finish is improved.



7. ALUMINUM permanent mold casting had over-all weight reduced. Note difference between milled and unmilled halves.



8. DIE CASTING walls are thinned to specifications. Magnesium parts seen above are sections of 10"-long castings.

chemical solution removes the individual grains of a metallic surface.

As in machining, the metallurgical structure of the metal is extremely important. Alloying constituents and any heat treating prior to chemical milling determine the metallurgical properties, and therefore directly affect the results that will be obtained with chemical milling. Microscopic examinations have shown that there is no chemical attack between grain boundaries and no change in the chemical composition of the surface due to chemical milling.

While the average milling rate is about .001 inch per minute, each metal reacts in a slightly different manner with the chemical solutions. Thus, a part of two or more metals will call for specially compounded etching chemicals, so that the difference in milling rates will be negligible.

Table II gives a list of casting alloys which have been chemically milled. Heat treating reduces the grain size of aluminum alloys. As a consequence of this finer grain, a better surface will result from chemical milling. At far as other metals are concerned, heat treating has little or no effect upon surface finish. Results of tests show that there is no change in the chemical, physical, or mechanical properties of metal parts that have been chemically milled.

CHEMICAL MILLING APPLICATIONS

Overall reduction was the first application of chemical milling to castings. The entire part was placed into the chemicals so that all dimensions are reduced by the same amount. In this case, every part of the casting had to be overdesigned to the same extent so that following the overall reduction, every section will have the proper dimensions.

TABLE II

Casting Alloys That Can be Chemically Milled

Material	Alloys
aluminum	356
magnesium	AZ-91A AZ-91C AZ-918 HK-31A EZ-33A ZK-51A
steel	347 410 304 17-4
titanium	commercially pure alloys

Controlled area chemical milling can now be accomplished by covering certain areas of a casting with a protective coating. The milling action is restricted to areas not coated. This eliminates the need to cast additional weight into sections that do not require it for casting ease.

With chemical milling, metal can be removed from almost any contoured surface, and wall thicknesses can be made paper-thin on certain castings, if required. Generally, minimum wall thickness is limited only by the porosity, homogeneity, and the tolerances of the casting. For example, many castings have a tolerance of about ± .015 inch.

continued on next page

CHEMICAL MILLING

continued from preceding page

Therefore, to prevent holes from being produced in the walls by chemical milling, they would have to be milled to slightly more than .030 inch. The "slightly more" will depend on the porosity and the homogeneity of the cast metal. The less the porosity and the greater the homogeneous quality of the material, the closer the casting can be milled. The exact limit must be evaluated on an individual basis for each casting.

An example of a chemically milled magnesium casting is shown in Figure 5. A comparison of some of the properties before and after chemical milling is given in Table I. The final thickness is not the minimum thickness that could be obtained on this part, but it is the thickness required by the purchaser of the casting. This particular section could be reduced to a gauge of .020 inch if required.

An example of how chemical milling is being used to reduce the weight of castings is demonstrated in the case of cast control surfaces for missiles. These sections are relatively thin and often are cast, rather than fabricated, to save the fabrication costs which are relatively high compared to the material costs.

However, the skins cannot be cast as thin as if they were riveted or welded on. This is because the supporting members in the interior of the casting are thicker than the skin. To equalize all the sections of the casting the skin must be made thicker than desired. This weight penalty is removed by chemically milling the outside surface to a very thin gauge. On some designs, weight savings of greater than 50%, compared to the original design, have been accomplished.

Results that can be obtained must be evaluated on an individual basis. It is difficult to guarantee specific chemical milling results for castings in general. Good results can be obtained on most castings if the proper solutions and the proper milling techniques are used. Also material composition and foundry practice will affect the milling.

TOLERANCES

Tolerances resulting from chemical milling are additive to the original material tolerances. Therefore, tolerances on the final part are very close to those obtained when the part was cast, since casting tolerances are always larger than chemical milling tolerances. The only way tolerances can be reduced is to make detailed measurements on each part to determine its actual dimensions. Under these conditions the final tolerances can be made extremely close to the present production chemical milling tolerances of ±.003 inch. However, this is generally not done.

SURFACE FINISHES

Surface finishes are generally improved by chemical milling. However, the surface improvement depends in part on the porosity of the casting and upon the alloying constituents. Finishes on aluminum castings, for example, depend on the silica content. After chemical milling, the surface finish should be 300 RMS or better. Surfaces of steel castings also are improved and are in the neighborhood of 125 RMS, depending on the original surface finish.

Magnesium and titanium alloys give a very fine surface finish. Their surfaces are so smooth that frequently either metal can be used where a lap joint is required. Finishes of 125 RMS or better are obtained consistently.

The resulting finish, in every case, will depend to a great extent on the casting process used. Best finishes are obtained from die cast-

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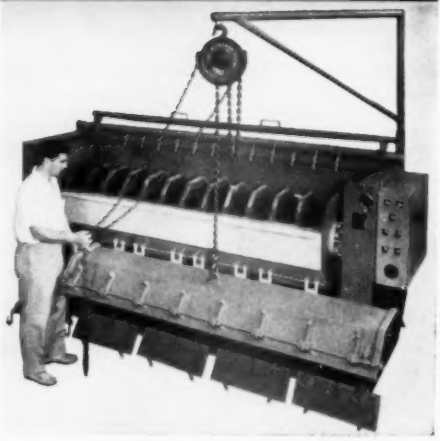

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BALLCONES	1/8" thru 3/16"		1/8" x 3/8"
CONES	1/8" thru 1/2"	PEBS	1/32" and 1/16"

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ings, and the roughest are obtained on sand castings. In addition, finishes will depend, to some extent, on the individual part and the depth of the cut.

Columnar grain growth is most pronounced in thick, chilled sections, in which a rougher surface will result. If a part has been cast by the permanent mold process, there will be a greater variation in the porosity than in some of the other casting techniques. Again, the surface finish will depend on the depth of cut.

It may appear that the surface finish on a cast part is almost impossible to predict. However, the results vary about the same as the results obtained by machining. Good consistent results can be obtained on any group of parts, if the alloying and the casting process are closely controlled.

DATA IN ADS *continued*

97. Metal Powders—Vanadium-Alloys Steel Company offers data sheets on stainless steel, alloy steel and special alloy powders.

98. Fire-Resistant Hydraulic Fluids—The booklet, "Ucon Hydrolubes Spell Safety", from Union Carbide Chemicals Co., includes laboratory test results and service records.

99. Alloy Hardeners—Z-3, an aluminum-magnesium hardener, and Z-5, an aluminum-magnesium-copper hardener, give manufacturing economies in producing No. 3 and No. 5 zinc die-casting alloys. Details are available from U. S. Reduction Co.

100. Die Steel—"Thermold AV" die casting die steel, stocked in flats, squares, rounds and billets, can be delivered within a few hours. Universal-Cyclops Steel Corporation offers a descriptive brochure.

101. Barrel Finishing—Abbott Ball Company's twelve compartment barrel gives big volume and low operating costs. Details are available on barrels and abrasives tailored to particular needs.

103. Chromate Color Coatings—for zinc-plated small parts are described in literature about "Luster-On Color" offered by Chemical Corporation.

105. Painting Masks—A 20-page book shows the different types of spray masks offered by Wm. M. Fiore, Inc. Includes case-study illustrations of their use in making precise registration possible.

106. Spin-Finishing—Information on one-operation finishing of complex parts is available from Grav-i-Flo Corp. The Spin-Finish process replaces hand and automatic buffing.

112. Smooth Cast Surfaces—Bulletin No. 6 tells how to get them with resin-bonded shell molds of "H-W Forsterite" grains, highly refractory magnesium silicates. Harbinson-Walker Refractories Company.

NEW GRAPHITE DEPOSIT LARGEST IN WEST

Reese & Hughes, mine operators, have opened up the largest known deposit of crystalline graphite in Western United States. Reserves are estimated to be in excess of 150,000,000 tons of high grade crystalline graphite. Production facilities have just been completed and the operation promises to become one of the largest producers of domestic graphite.

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FIBER METALLURGY

continued from page 53

look promising for plastic sheet metal molding dies having increased life and strength.

B. Metal fiber reinforced ceramics are made by several techniques:

1. Sintered felts can be infiltrated or impregnated in a porous die by a ceramic slurry.

2. Metal fibers can be mechanically blended with ceramic powders and the mixture can be hot or cold pressed.

The felted or pressed metal fiber-ceramic composites are sintered or hot pressed to achieve final density.

These materials are essentially nonporous and have a structure consisting of two continuous interpentrating phases, one of metal and one of ceramic. This unique structure provides a material with the high-temperature strength and wear properties of a refractory ceramic with a considerable toughness and thermal conductivity contribution by the metal network.

By suitable matching of thermal contraction properties of the metal and ceramic phases, the ceramic can be hydrostatically compressed upon cooling from sintering or hot pressing temperatures. Such prestressing can improve physical properties in a manner analogous to prestressed concrete.

A high energy friction material for aircraft applications was developed on the basis of this structure and has been successfully tested on an inertia type dynamometer.

For a material consisting of 50% by volume of a molybdenum fiber network phase and a nonmetallic phase of 30% SiC, 10% Fe-Si and 10% C, a total energy of 4,560,000 foot-pounds per square inch of friction material surface was dissipated in 94 stops.

The friction material wear was about 0.00007 inch per stop and the material was still serviceable after testing. The coefficient of friction ranged from 0.11 to 0.15.

Because the thermal conductivity and toughness—contributions of the metal network in the ceramic—have been observed to improve the thermal shock resistance as well as the physical properties of ceramics for metal contents as low as 10 volume per cent, many other applications are sure to follow. There is particular interest in the missile field.

C. Soft metals such as lead or magnesium can be reinforced if they contain a strong metal fiber network. In many cases the soft metal can be cast into the fiber network. Items such as non-sagging lead or steel-magnesium fragmentation armor are being investigated.

D. The possibilities for useful composites containing metal fiber networks are practically endless.

Bronze-lead bearing alloys, metal-asbestos fire walls, metal reinforced wallboard and many others have been suggested.

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PMM BOOKS

PRINCIPLES OF THE PROPERTIES OF METALS, By Jacob P. Frankel, McGraw-Hill Book Co., Inc., New York, N.Y. Price $6.00

This book represents a new approach to the subject by emphasizing principles and properties rather than materials. Intended as an introduction to all fields of engineering, the book is based on a series of lecture notes for classes in the properties of materials at Northwestern Technological Institute.

Discussions on such matters as magnetic properties and some of the properties of liquids have been omitted.

A synopsis, at the beginning of each chapter, presents the most important principles to be covered. The body of the chapters are devoted to an exposition of the logical derivation and the use of the principles.

Numerous charts and illustrations are included.

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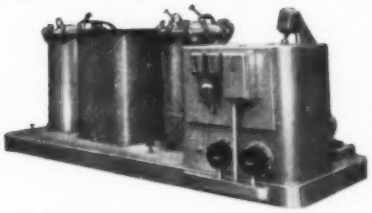

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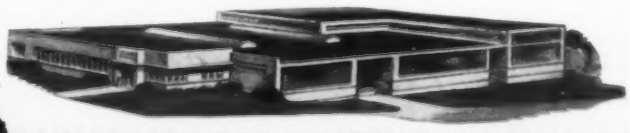

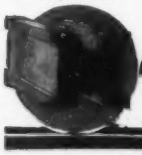

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any of these technical publications may be obtained by circling the appropriate numbers on the Reader Service Cards, Pages 56-57

PROCESSES

Powder Metallurgy: 154
Compacted Metals Corporation—Advantages of the process in production of small parts, design pointers and physical characteristics of powdered metal are covered in a technical brochure.

Centrifugal Casting: 155
American Brake Shoe Co.—An illustrated booklet discusses centrifugal casting of bronze and copper parts. Includes a description of the technique, a chart showing characteristics of available alloys and a list of facilities and engineering services.

MATERIALS & EQUIPMENT

Induction Heating: 156
Lepel High Frequency Laboratories, Inc.—Vol. 1, No. 2 of the High Frequency Heating Review includes application data for induction heating and information on some new equipment.

Refractory Mold Casting: 157
Shaw Process Development Corporation—The "Refractocast" process, a method of investment casting without using expendable patterns, is explained in a technical brochure. Perfected in England, the process is licensed in North and South America by Shaw.

Annealing Effects: 158
Hoeganaes Sponge Iron Corporation—Machinability of sintered iron-carbon compositions is the subject of a new research report. Microphotos and a table show progressive changes in appearance and machinability of test bars after annealing 0-60 minutes.

Powder Compacting Press: 159
A. Johnson & Co., Inc.—A line of presses designed to produce complex shapes with uniform density, using the "withdrawal" type tooling system, is described in new engineering literature. Complete operating and physical specifications and dimensional drawings are included.

Vacuum Arc Melting Furnace: 160
Kinney Mfg. Div., The New York Air Brake Co.—Bulletin 808 describes the F-10, a new Laboratory Vacuum Arc Melting Furnace for melting, alloying, consolidating or refining very high temperature metals and alloys. The furnace can employ consumable or non-consumable electrodes. It is specifically designed for vacuum or inert gas melting of stable or reactive metals.

Vacuum Furnaces: 161
Kinney Mfg. Div., New York Air Brake Co.—Literature describes the new developments in high vacuum melting, annealing, brazing, welding, sintering, stream degassing and heat treating and the High Vacuum Furnace to fit your needs.

Dehydrators: 162
Selas Corp. of America—Selas Dehydrators, designed and built to meet specific needs for removal of moisture from most gases, are described in Bulletin SC-1013. Typical gases handled include Carbon Dioxide, Carbon Monoxide, Hydrocarbons, Nitrogen, Inert gases and others.

Cold Chambers: 163
Advance Products Corp.—Information on the facilities of the company for making delivery in 10 to 14 days on cold chambers of the highest quality, is available.

Die Cast Fasteners: 168
Gries Reproducer Corp.—An expanded line of die cast zinc alloy threaded fasteners and a new line of molded nylon fasteners are presented in a new 6-page catalog.

FINISHING

Mass Production Finishing: 164
Mecha-Finish Corporation—Automatic fixture-finishing equipment which can form radii as small as .0001" is explained and illustrated in a 10-page booklet. In the "Mechamatic" process, parts to be finished are rotated with or against the abrasive flow.

Phosphating Compounds: 165
Oakite Products, Inc.—Two brochures are available which give step-by-step instructions in the use of CrysCoat No. 89, an iron phosphating compound and CrysCoat HC, a zinc phosphating compound. Steel treated with CrysCoat acquires a tougher finish with less paint required.

Rubberized Abrasives: 166
Cratex Manufacturing Co.—The latest Cratex Industrial Catalog contains 8-pages of advanced application information, operating instructions, tables, illustrations and latest technical information.

Chemical Treatments Guide: 167
American Chemical Paint Company—A new 8-page brochure describes chemical conversion coatings for steel, aluminum, galvanized iron, zinc and cadmium plated surfaces; for corrosion resistance, paint bonding, drawing and forming and protecting friction surfaces.

Finishing Systems: 169
Schmieg Industries Inc.—Bulletin 600 features isometric drawings of custom designed equipment for washing, baking and painting, from single units up to complete push-button systems.

Zinc Plating Brighteners: 170
Allied Research Products, Inc.—Technical data is available on two new brighteners for cyanide zinc plating solutions – ARP 32, a powdered additive which provides brightness over the entire plating

continued on page 62

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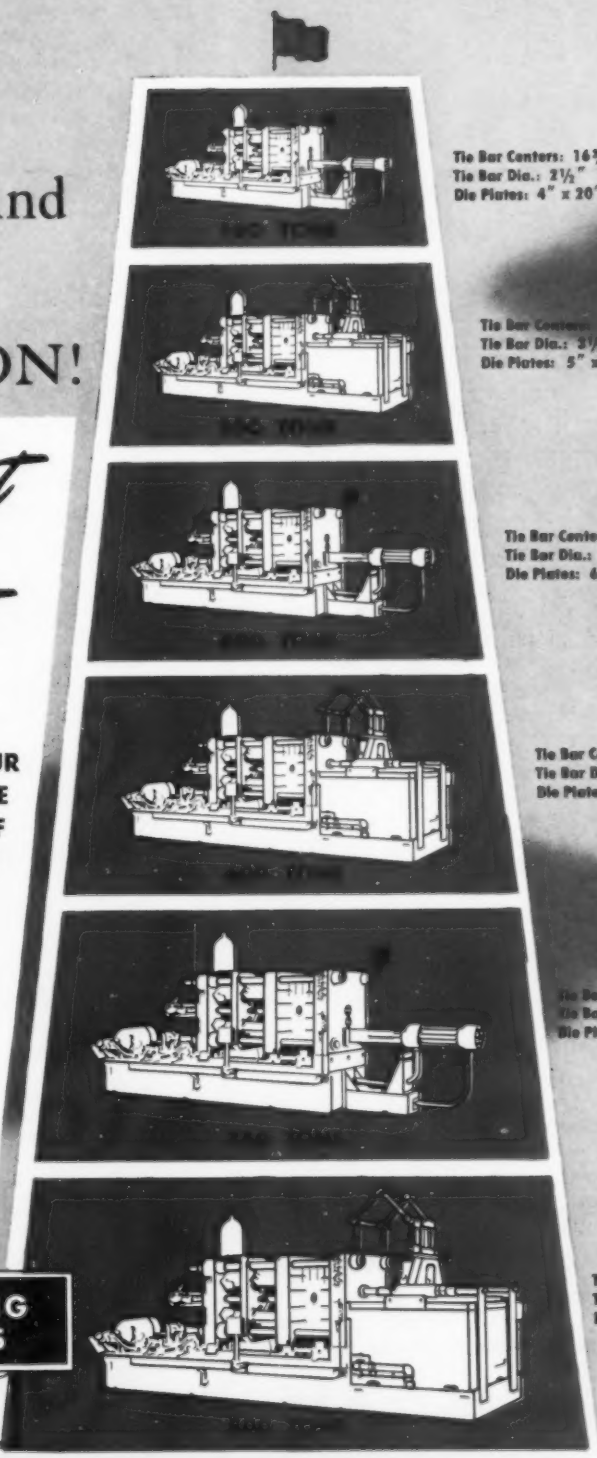

Tie Bar Centers: 16¾" x 14¾"
Tie Bar Dia.: 2½"
Die Plates: 4" x 20" x 22"

Tie Bar Centers: 22½" x 22½"
Tie Bar Dia.: 3½"
Die Plates: 5" x 29" x 31"

Tie Bar Centers: 28" x 24"
Tie Bar Dia.: 4"
Die Plates: 6" x 44" x 30"

Tie Bar Centers: 33" x 33"
Tie Bar Dia.: 5"
Die Plates: 7" x 46" x 44"

Tie Bar Centers: 36½" x 36½"
Tie Bar Dia.: 6"
Die Plates: 9" x 48" x 48"

Tie Bar Centers: 3[illegible]
Tie Bar Dia.: 6½"
Die Plates: 9" x 5[illegible]

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USEFUL LITERATURE . . .

continued from page 60

range in still and automatic tanks, and ARP 53, a low cost liquid additive for barrel plating.

Nickel Stripping Solution: 171
Hanson-Van Winkle-Munning Co.—Complete information is offered on Ni-Plex, a non-toxic compound which will remove electrolytically deposited nickel and nickel-cobalt plating from any base metal. It has little or no effect on metals other than nickel and cadmium, removes .0001 inch depth plating at a chemical cost of 3.2 cents per square foot.

Blast Cleaning Ideas: 172
Wheelabrator Corporation—Catalog No. 143-D is a 28-page handbook of blast cleaning, finishing and shot peening ideas utilizing the airless abrasive blast method. Applications, features and specifications for specific types of Wheelabrator blast cleaning machines are also given.

Self-Locking Set Screws: 173
Set Screw & Mfg. Co.—A new selector chart enables engineers and specifiers to evaluate opportunities for the use of self-locking set screws. 1,001 separate combinations of fasteners are shown for applications ranging from hardened steel to plastics.

Protective Coating: 174
Mono-Seal Products—The basic characteristics of Mono-Seal, a balanced chemo-setting synthetic resin coating, are given along with complete technical data on application, drying times, coverage and surface preparation, in a 12-page brochure.

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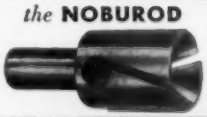

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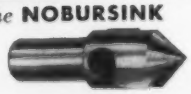

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6860 Farmdale Ave., No. Hollywood, California

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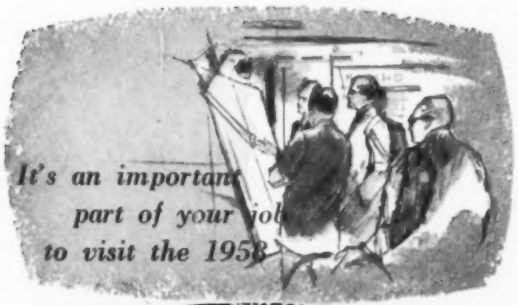

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APRIL 14-17, 1958

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Design Engineering Show
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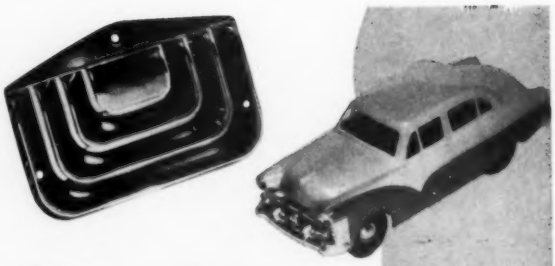

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APRIL 1958

PMM 7th Annual

POWDER METALLURGY DIRECTORY

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METAL

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1 REFERENCE DATA

2 PRODUCT LISTING

3 BUYERS' GUIDE

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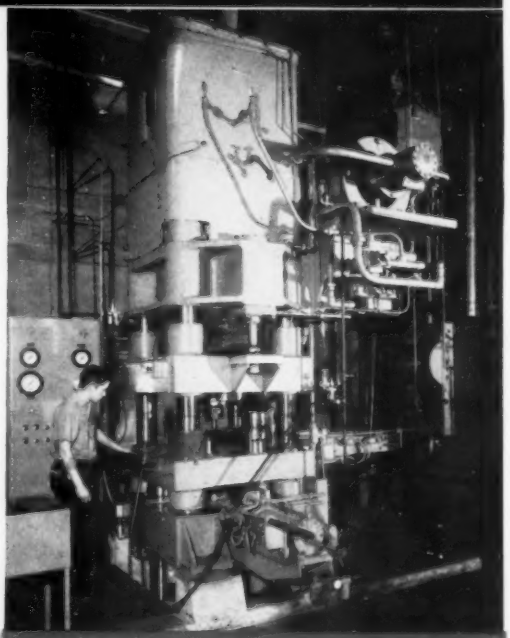
Latest addition to the constantly expanding powdered metal facilities at Burgess-Norton is this 500-ton compacting press, largest of its type ever built. Exceptional facilities are only part of the Quali-SINT story. Engineering skill, quality control and wide experience in solving some of the toughest production problems in the industry are among the other reasons so many manufacturers are turning to B-N® for cost-saving sintered steel parts.



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7th annual

POWDER METALLURGY DIRECTORY

SECTION 1

Advances in Powder Metallurgy

Asked for their comments on new, significant developments in the field of powder metallurgy, these major suppliers of equipment and materials outlined current advances.

THE GLIDDEN CO., Chemicals-Pigments-Metals Div.

Powder metallurgy is advancing on many fronts. The exciting applications, particularly in missiles, rockets, and atomic reactors, require metals with unusual properties. Thorium and uranium, because of their large nuclear cross sections, are especially useful in atomic reactors and powder metallurgical techniques can be used to fabricate them. In a modern commercial process for making the powders, uranium-hydride is formed first.

The hydride is then decomposed thermally. This hydride is made by reaction of uranium with hydrogen at 390°F - 430°F and is decomposed to uranium powder with an average particle size of 3 - 10 microns by heating, under reduced pressure, at 570°F - 750°F. The powder is highly pyrophoric. A similar technique is used to make thorium powder.

Thorium and uranium powders can be sintered by conventional techniques. Compacting pressure, sintering time, temperature and atmospheres need special consideration because they affect the properties.

Titanium powder has a variety of potential metallurgical applications, particularly were high chemical and wear resistance requirements are needed. Industry has been slow to accept titanium due to purity problems, but this is becoming less of a problem. Fabricating is by pressing the powder to 85%-90% of theoretical density at about 50 TSI, followed by vacuum sintering at 1500°F - 2000°F. Tensile strength of sintered parts is greatly increased by alloying with 6% aluminum and 4% manganese.

Cermets are a new class of materials out of which can be made aircraft components to work at high temperatures. These materials can also be used for such things as high temperature seals and bearings.

Vacuum sintering is of great importance in the powder metallurgy of easily oxidized metals and those that suffer hydrogen embrittlement. Examples are titanium and zirconium. With vacuum sintering, reaction with oxygen, nitrogen, and hydrogen is avoided, resulting in more ductile compacts. The vacuum sintering process is generally a batch operation.

No longer an experiment, many metal powders can be rolled into sheets. The technique is valuable in making sheet thorium, plutonium, and uranium.

VANADIUM-ALLOYS STEEL CO.

There is an increasing use of stainless steel powders. New designs for industrial filters are calling for increased capacity with minimum volume and weight. These requirements are easily and economically met by stainless steel powder components. The use of stainless steel structural parts is also increasing as designers concentrate on maximum economy for all fabrication.

A whole new field of powder metallurgy is opening up in atomic energy work. Powder processing offers the most promising way to combine the reactive and base metals that operate and control reactors. Both fuel elements and control rods by powder metallurgy processing are performing satisfactorily in pilot operations.

EATON MFG. CO., Powdered Metals Div.

An ever increasing number of manufacturers are relying on the powdered metal process to enable them to obtain necessary cost reductions. This has forced the powdered metal parts manufacturers to make parts they would not have attempted a few years ago. These new parts have been made possible by the combined efforts of the powdered metallurgist, tool and die designer, and the many vendors to the powdered metal industry.

Porous metal powder parts have been plated so that this plating serves more than a decorative function.

Mass production of parts are now being run where yearly quantities are in the millions. These cadmium plated parts have a salt spray testing life in excess of 350 hours.

Metal parts in the density range of 6.5 to 6.8 g/cc can now be consistenly induction hardened to Rockwell C42 to 50 and with a mirco hardness of Rockwell C 60 to 64. These parts exhibit a minimum of distortion during heat treatment and can be run in production at a very high volume.

New materials are available where improved tensile strengths can be obtained. High density parts that are pressed and sintered only, can have tensile strengths of 65,000 p.s.i. High density parts that are subsequently coined after sintering can have tensile strengths of 100,000 p.s.i. By utilizing the infiltration process of copper into steel it is possible to obtain tensile properties in excess of 175,000 p.s.i. By utilizing this same process, without the addition of carbon, tensile strengths of 75,000 p.s.i. can be obtained with 20% elongation.

THE NEW JERSEY ZINC COMPANY

While many metal powders experienced a slight downward trend in structural parts useage, brass powder showed continuing strength. A part of this increase came from the wider use of brass powder as an infiltrant.

A large percentage of the iron parts now being made are infiltrated and some 20% to 25% of the weight of the finished part is, therefore, brass.

New techniques in infiltration have been developed that allow the process to be used on large and heavy parts without the discoloration and pitting generally associated with infiltrated parts.

High tensile strengths can be secured with iron compacts infiltrated with brass. SAE specifications give a nominal tensile strength of 75,000 psi. With heat treating this can be increased to over 100,000 psi. This is, of course considerably higher than can be secured from free machining screw stock such as 1117 or 1113.

LINDBERG

LINDBERG ENGINEERING CO.

The establishment of a definite relationship between carbon content and dew point of endothermically produced furnace atmospheres permits the powder metallurgist to make a wide variety of plain carbon steels or low alloy steels that are hardenable by normal heat-treating methods. This widens, for the design engineer, the field of usefulness of sinterings.

With a standard endothermic gas generator it is possible to adjust the dew point to give the desired carbon potential in the furnace by simple generator ratio adjustment, for carbon contents of 0.50% or lower. When the carbon content of the steel is to exceed 0.50%, some carbon in the form of a volatile hydrocarbon must be added to the atmosphere just before it enters the furnace. Natural gas or propane are most widely used for this purpose.

Fully automatic recording equipment has been developed that will ensure the proper carbon potential in the furnace atmosphere so that sinterings of controlled carbon content can be produced.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

The commercial availability of aluminum powder metallurgy products (APMP) represents a major break through the thermal barrier which has barred the use of aluminum in many high temperature applications.

With the development of APMP, aluminum products can be operated at temperatures up to 900°F, an advance of 300°F to 400°F. This is particularly important in aircraft and missiles since every reduction instructural weight means more fuel or greater payload.

APM products have some properties that make them more useful than titanium or steel. They cost less than titanium and are easier to fabricate. They have a higher thermal conductivity than either titanium or stainless steel.

Three APM alloys are now available, one made from domestically produced aluminum powder and the other two from powder imported from Switzerland. The powder, with a controlled oxide layer on the surface, is pressed and sintered under carefully controlled conditions. The compacts are then ready for extruding, rolling or forging.

HEVI-DUTY®

HEVI-DUTY ELECTRIC CO.

Mesh belt furnaces that will operate at temperatures up to 2100°F and handle up to 400 lb. per hour of small parts are now regular production units. These furnaces incorporate a charge table, of purge zone, a multiple temperature sintering zone, an insulated cooling chamber and a discharge table. This type of furnace can be built for any operating conditions desired.

However, newer developments in powder metallurgy are toward larger, heavier pieces that must be sintered at higher temperatures. These demands have led to the development of pusher type furnaces capable of handling very heavy loads and operating at temperatures up to 3100°F.

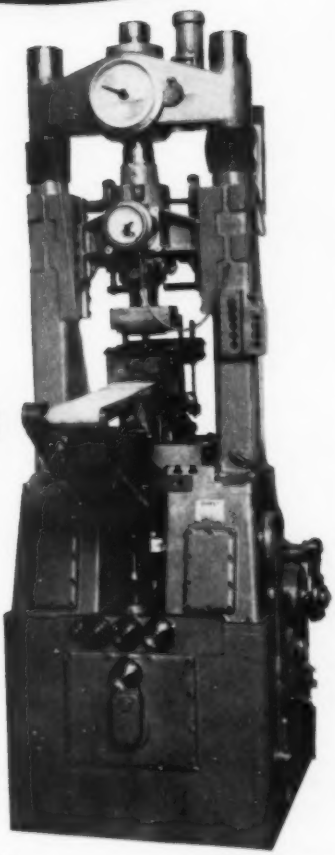
The growing use of the highly reactive metals such as titanium and zirconium and the generally superior metallurgical properties secured, have led many fabricators to use vacuum furnaces.

These furnaces are available in both bell and pit types with both single and double pumping units.

continued on page 91

NEW

DORST DA-100



Height: 11.8 feet (Fully Extended)

Automatic powder metal press

OUTSTANDING FEATURES:

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- All movements fully synchronized
- Fully mechanical with hydraulic pressure indicator
- Motorized precision adjustment for top cross head
- Centrally located controls with micrometer adjustment for floating die action; independent fill adjustment for tools with several fill levels; independent timing adjustment for compression from top and bottom; ejection adjustment

This is only one of a complete line of powder metal presses Top engineering and maintenance services.

For demonstration contact:

DORST DIVISION ARNHOLD CERAMICS, INC.
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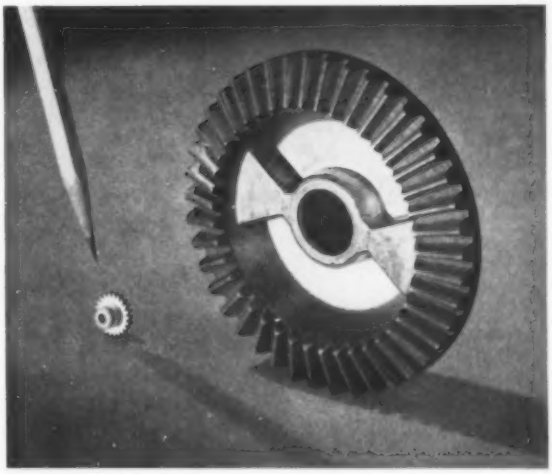
HOW CAN BRASS POWDER METALLURGY HELP YOU?



BY CUTTING COSTS . . . . . INSTEAD OF CUTTING PARTS

This large transmission gear for a man-carrying power mower once cost $1.56 each as a machined sand casting. Now, as a stronger, brass-infiltrated powder metal part, it costs $1.10. — **A COST SAVING OF 29%**

As a machined part, the small brass gear once cost 16¢ each. Now made as a brass powder sintering, the cost is only 6¢. — **A COST SAVING OF 62½%**

A powder metal fabricator can show you how brass powder metallurgy can help your products the same way — and with many other advantages, too.

THIS BOOKLET
will assist you in evaluating this modern production method in terms of your particular needs.

SEND FOR YOUR COPY

THE NEW JERSEY ZINC COMPANY
160 Front Street, New York 38, N. Y.

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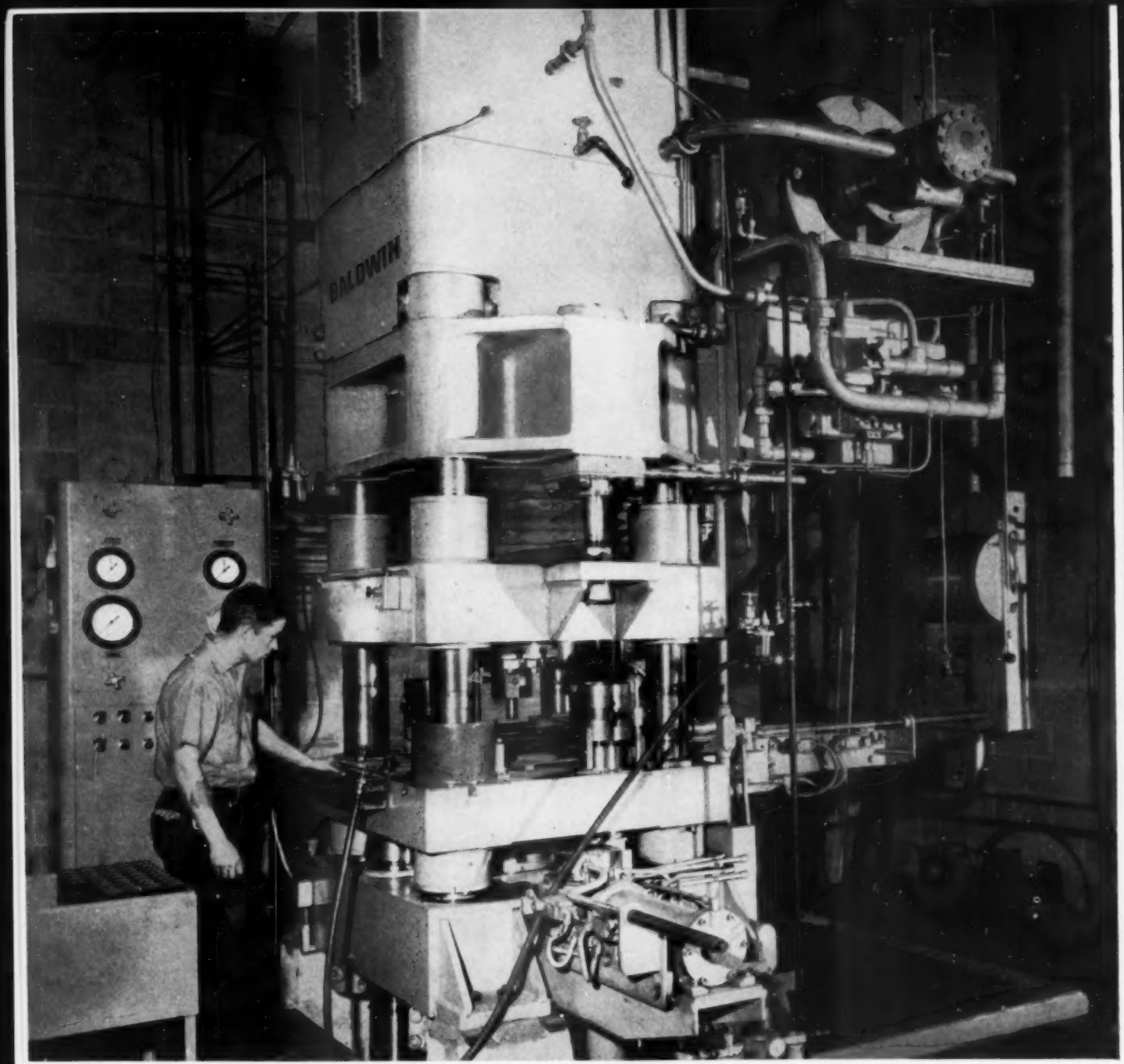

New Baldwin hydraulic press

Combines high tonnage capacity with multiple motions normally found in small presses

Pictured above is a new 500-ton-capacity Hamilton hydraulic compacting press now in operation at the Burgess-Norton Mfg. Co., Geneva, Ill. Designed for compacting powdered metals, the new press embodies these features proven desirable in Baldwin's line of smaller presses:

Floating die • Automatic cycling • Dye float control
Shuttle feeder • Accurate load downstops

These motions are made possible even in high tonnages at relatively low cost. The press features convenient control of the forces being exerted—and accurate control of the finished size of the part being formed.

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POWDER METALLURGY DIRECTORY

SECTION 2

PRODUCT LIST

BEARINGS

Copper Base

Allied Products Corp.
Powdered Metal Parts Div.
American Powdered Metals, Inc.
American Sinteel Corp.
Arrow Sintered Products Co.
Asco Sintering Corp.
Bassick Co., The
Bound Brook Oil-Less Bearing Co.
Brockway Pressed Metals, Inc.
Bunting Brass & Bronze Co., The
Carbon City Products Co., Inc.
Ceromet, Inc.
Chicago Powdered Metal Products Co.
Chrysler Corp.
Amplex Div.
Clevite Corp.
Clevite Limited
Compacted Metals Corp.
Deva-Metal Corp.
Dixon Sintaloy, Inc.
Eaton Mfg. Co.
Powdered Metals Div.
Engineered Plastics, Inc.
American Sinterings Div.
Federal-Mogul-Bower Bearings, Inc.
Ferro Powdered Metals
Ford Motor Co.
Accessory Div.
General Sintering Corp.
Indar Corp.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc., Rocky Mountain Metals Div.
Johnson Bronze Co.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Moraine Products Div.
General Motors Corp.
Mueller Brass Co.
National Molded Products, Inc.
Norwalk Powdered Metals, Inc.
Pacific Sintered Metals Co.
Parker White Metal Co.
Picco, Inc.
Powder Metal Products, Inc.
Powdercraft Corp.
Precision Metal Products Co.
Presmet Corp., The
Pure Carbon Co., Inc.
Reese Metal Products Corp.
St. Marys Carbon Co.
Sintered Metals, Inc.
Standard Automation Products
Sterling Engineering Corp.
Superior Carbon Products, Inc.
Symmco, Inc.
Wakefield Bearing Corp.
Western Sintering Co.
Wickes Corp., The
The United States Graphite Co. Div.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Iron Base

Allied Products Corp.
Powdered Metal Parts Div.
American Powdered Metals, Inc.
American Sinteel Corp.
Arrow Sintered Products Co.
Asco Sintering Corp.
Bassick Co., The
Bound Brook Oil-Less Bearing Co.
Brockway Pressed Metals, Inc.
Bunting Brass & Bronze Co., The
Carbon City Products Co., Inc.
Ceromet, Inc.
Chicago Powdered Metal Products Co.
Chrysler Corp.
Amplex Div.
Clevite Corp.
Clevite Limited
Compacted Metals Corp.
Deva-Metal Corp.
Dixon Sintaloy, Inc.
Eaton Mfg. Co.
Powdered Metals Div.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
Ford Motor Co.
Accessory Div.
General Sintering Corp.
Indar Corp.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc., Rocky Mountain Metals Div.
Johnson Bronze Co.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Moraine Products Div.
General Motors Corp.
Mueller Brass Co.
National Molded Products, Inc.
Norwalk Powdered Metals, Inc.
Pacific Sintered Metals Co.
Parker White Metal Co.
Picco, Inc.
Powder Metal Products, Inc.
Powdercraft Corp.
Precision Metal Products Co.
Presmet Corp., The
Pure Carbon Co., Inc.
Reese Metal Products Corp.
St. Marys Carbon Co.
Sintered Metals, Inc.
Standard Automation Products
Sterling Engineering Corp.
Superior Carbon Products, Inc.
Symmco, Inc.
Wakefield Bearing Corp.
Western Sintering Co.
Wickes Corp., The
The United States Graphite Co. Div.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Other Types

Chrysler Corp.
Amplex Div.
(silver)
Deva-Metal Corp.
(nickel)
General Sintering Corp.
(wear resistant alloys)
Kwikset Powdered Metal Products
(stainless steel, nickel)
Wakefield Bearing Corp. (babbitt)

CEMENTED CARBIDES

All Types

Adamas Carbide Corp.
Eaton Mfg. Co.
Powdered Metals Div.
Firth Sterling, Inc.
General Electric Co.
Metallurgical Products Dept.
General Sintering Corp.
Indar Corp.
Kennametal, Inc.
Mallory-Schwarzkopf Metals, Inc.
National Diamond Laboratory
Sintercast Corp. of America
Tungsten Alloy Mfg. Co., Inc.
Union Wire Die Corp.
Valenite Metals
Welded Carbide Tool Co., Inc.
Wesson Metal Corp.

CONTACT MATERIALS

Pure Metals (Platinum, Silver, Etc.)

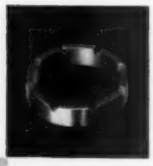
Chrysler Corp.

a new expanded field of

BEARING DESIGN and APPLICATION

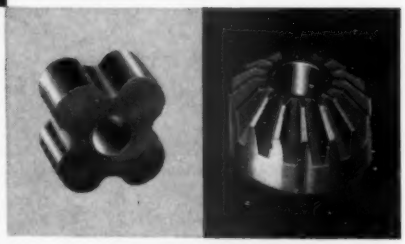
The inauguration of Bunting's new facility for engineering and manufacturing bearings and parts of Sintered Powdered Metals opens a wide new area of opportunity to all mechanical industry.

Sintered Powdered Metal Bearings and parts offer real economies in design. Bunting Engineering and manufacturing skill and traditional technical responsibility assure your most advantageous use of this material.



A competent group of Bunting Sales Engineers in the field and a soundly established Product Engineering Department put at your command, comprehensive data and facts based on wide experience in the designing and use of both Cast Bronze and Sintered Powdered Metal Bearings and parts.

Write for catalogs and your copy of the new 24 page Bunting Engineering handbook of Sintered Powdered products and their composition, manufacture and application.



Bunting®

BUSHINGS, BEARINGS, BARS AND SPECIAL PARTS OF CAST BRONZE AND POWDERED METAL

The Bunting Brass and Bronze Company • Toledo 1, Ohio • Branches in Principal Cities

For more information circle No. 23 on the Reader Service Card

Amplex Div.
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Baker Contact Div.
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General Sintering Corp.
Gibson Electric Co.
Globe Industries, Inc.
Supermet Div.
Handy & Harman
Kulite Tungsten Co.
P. R. Mallory & Co., Inc.
Metal Ceramics
Metroloy Co.
Powder Metals Research
St. Marys Carbon Co.
Sintered Metals, Inc.
Superior Carbon Products, Inc.
Technametals, Inc.
Wakefield Bearing Corp.

Tungsten Copper, Tungsten Silver, Etc.

Compacted Metals Corp.
Engelhard Industries, Inc.
Baker Contact Div.
Fansteel Metallurgical Corp.
Gibson Electric Co.
Handy & Harman
Keystone Carbon Co.
Kulite Tungsten Co.
Kwikset Powdered Metal Products
P. R. Mallory & Co., Inc.
Metal Ceramics
Powder Metals Research
St. Marys Carbon Co.
Stackpole Carbon Co.
Superior Carbon Products, Inc.
Technametals, Inc.

CORES

Ferrites

Aerovox Corp.
Crowley Div.

High Frequency

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Crowley Div.
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Engineered Plastics, Inc.
American Sinterings Div.
Ferroxcube Corp. of America
Indar Corp.
Jet Components, Inc.
Kwikset Powdered Metal Products
Magnetic Core Corp.
Magnetics, Inc.
Micrometals
National Moldite Co.
Pyroferric Co., Inc.
Quality Components, Inc.
Radio Cores, Inc.
Stackpole Carbon Co.

Low Frequency

Aerovox Corp.
Crowley Div.
Arnold Engineering Co., The
Custom Components, Inc.
Engineered Plastics, Inc.
American Sinterings Div.
Ferroxcube Corp. of America
Indar Corp.

Jet Components, Inc.
Kwikset Powdered Metal Products
Magnetic Core Corp.
Micrometals
National Moldite Co.
Pyroferric Co., Inc.
Quality Components, Inc.
Radio Cores, Inc.
Stackpole Carbon Co.

ELECTRICAL COMPONENTS

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Bunting Brass & Bronze Co., The
Chrysler Corp.
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Clevite Limited
Dixon Sintaloy, Inc.
Eaton Mfg. Co.
Powdered Metals Div.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
General Sintering Corp.
Gibson Electric Co.
Kwikset Powdered Metal Products
P. R. Mallory & Co., Inc.
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Norwalk Powdered Metals, Inc.
Parker White Metal
Powdercraft Corp.
Sintered Metals, Inc.
Superior Carbon Products, Inc.
Wicks Corp., The
The United States Graphite Co. Div.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Commutator Segments

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Bunting Brass & Bronze Co., The
Chicago Powdered Metal Products Co.
Chrysler Corp.
Amplex Div.
Clevite Limited
Dixon Sintaloy, Inc.
Eaton Mfg. Co.
Powdered Metals Div.
Eberhart Steel Products
Powdered Metals Div.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
General Sintering Corp.
Gibson Electric Co.
Kwikset Powdered Metal Products
Merriman Bros., Inc.
Metal Ceramics
Norwalk Powdered Metals, Inc.
Sintered Metals, Inc.
Wicks Corp., The
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Yale & Towne Mfg. Co., The
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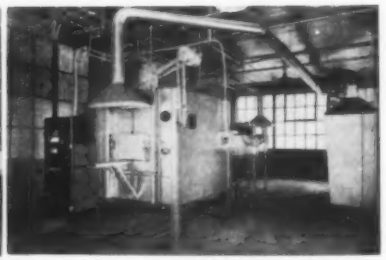
Pole Pieces

Allied Products Corp.
Powdered Metal Parts Div.

THE ELECTRIC FURNACE CO. Salem Ohio. Gas Fired, Oil Fired and Electric Furnaces. EF

EF FURNACES *for Sintering* Metal Powder Products

A large capacity EF combination gas fired radiant tube and electrically heated roller hearth type furnace for sintering metal powder parts at temperatures up to 2050°F.



A comparatively small EF hand operated pusher type electric furnace suitable for experimental work and small production runs on both ferrous and non-ferrous products.

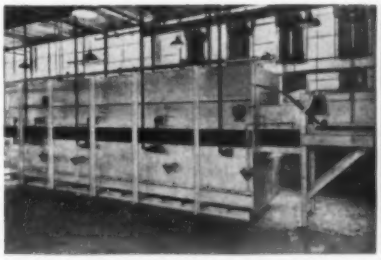
EF furnaces for processing ferrous and non-ferrous powder products assure:

- **lowest cost per pound for the sintering operation.**
- **maximum uniformity of size for the sintered products.**
- **maximum pounds of quality product per dollar invested.**

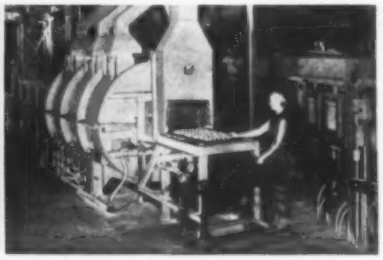
Long experience with special atmospheres, metal powders, bonding powder to strip and all heat processing phases connected with powder metallurgy has enabled EF engineers to develop and install equipment for producing some rather outstanding results.

With our extensive experience and complete manufacturing facilities we are in position to build the size and type equipment to best suit your specific requirements.

We would like to discuss some of our latest furnace developments with you, if interested.



Fusing metal powder to strip. Metal powder is being fused on six separate strands of strip, simultaneously and continuously, in this EF roller hearth type furnace.



An EF gas fired muffle type continuous furnace—another of the numerous types we build for sintering non-ferrous and iron powder products at various temperatures.

EF

BULLETIN No. 461
shows typical installations of EF Gas-fired, Oil-fired and Electric Furnaces.
Send for a copy today!

THE ELECTRIC FURNACE CO.
GAS-FIRED OIL-FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT, OR PRODUCTION *Salem - Ohio*
Canadian Associates • CANEFCO, LIMITED • Toronto 1, Canada

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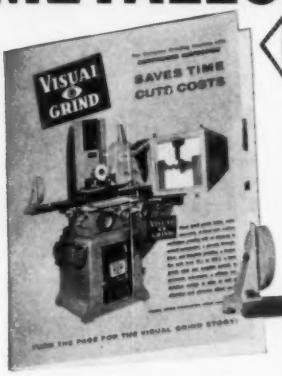
FREE BROCHURE shows How You Can CONTOUR GRIND Dies for POWDER METALLURGY!



IMPORTANT TO YOU!

Free booklet tells how VISUAL GRIND facilitates construction of precision high-production dies, dies for powder metallurgy, lamination dies and special purpose dies. VISUAL GRIND permits through, blind and templet grinding . . . permits continuous inspection by magnifying work from 10:1 to 100:1 . . . upgrades semi-skilled labor . . . permits easy maintenance of dies in your own plant . . . reduces costly down time. VISUAL GRIND COMPLETES YOUR TOOL ROOM.

Visual Grind solves the problem in mind

Intricate grinding jobs like those shown above ordinarily involve several machines. ALL WERE FORM GROUND ON A SINGLE VISUAL GRIND.

CLIP and MAIL THIS COUPON TODAY

The CLEVELAND GRINDING MACHINE Co.

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Please send me the free brochure describing the capabilities of the VISUAL GRIND.

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Compacted Metals Corp.
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Powdered Metals Div.
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Kwikset Powdered Metal Products
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Metal Ceramics
Metal Powder Products, Inc.
Moraine Products Div.
General Motors Corp.
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Pacific Sintered Metals Co.
Parker White Metal Co.
Picco, Inc.
Sintered Metals, Inc.
Stackpole Carbon Co.
Wickes Corp., The
The United States Graphite Co. Div.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Rotor Segments

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Bunting Brass & Bronze Co., The
Chrysler Corp.
Amplex Div.
Clevite Limited
Dixon Sintaloy, Inc.
Eberhart Steel Products
Powdered Metals Div.
Engineered Plastics, Inc.
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Ferro Powdered Metals
General Sintering Corp.
Kwikset Powdered Metal Products
P. R. Mallory & Co., Inc.
Merriman Bros., Inc.
Metal Ceramics
Norwalk Powdered Metals, Inc.
Picco, Inc.
Sintered Metals, Inc.

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Amplex Div.
General Metals Powder Co., The
General Sintering Corp.
Kwikset Powdered Metal Products
Moraine Products Div.
General Motors Corp.
Powdercraft Corp.
Raybestos-Manhattan, Inc.

S. K. Wellman Co., The

MAGNETIC MATERIALS

Hard — Alnico Type

Arnold Engineering Co., The
Compacted Metals Corp.
Ferroxcube Corp. of America
General Electric Co.
Magnetic Materials Sec.
General Electric Co.
Metallurgical Products Dept.
General Magnetic Corp.
Indar Corp.
Indiana Steel Products Co., The
Jet Components, Inc.
Permag Corp.
Presmet Corp., The

Hard — Other Types

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Crowley Div.
Ferroxcube Corp. of America
Indiana Steel Products Co., The
International Powder Metallurgy Co., Inc.
National Moldite Co.
Stackpole Carbon Co.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Soft

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Crowley Div.
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Chrysler Corp.
Amplex Div.
Dixon Sintaloy, Inc.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
Ferroxcube Corp. of America
General Aniline & Film Corp.
Antara Chemicals Div.
General Sintering Corp.
Indar Corp.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc.
Rocky Mountain Metals Div.
Keystone Carbon Co.
Merriman Bros., Inc.
Metal Ceramics
Pacific Sintered Metals Co.
Parker White Metal Co.
Powdercraft Corp.
Wakefield Bearing Corp.

Iron Nickel

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Chrysler Corp.
Amplex Div.
Dixon Sintaloy, Inc.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
General Sintering Corp.
International Powder Metallurgy Co., Inc.
Rocky Mountain Metals Div.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Moraine Products Div.
General Motors Corp.
National Moldite Co.
Parker White Metal Co.
Powdercraft Corp.
Presmet Corp., The
Sintered Metals, Inc.
Wakefield Bearing Corp.

Iron Silicon

American Sinteel Corp.
Asco Sintering Corp.
Chrysler Corp.
Amplex Div.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
General Sintering Corp.
Kwikset Powdered Metal Products
National Moldite Co.
Parker White Metal Co.
Presmet Corp., The
Sintered Metals, Inc.
Wakefield Bearing Corp.

Other Types

American Sinteel Corp.
(pure iron)
Keystone Carbon Co.
(pure iron)
Powdercraft Corp.
(pure iron)

STRUCTURAL PARTS

Brass

American Powdered Metals, Inc.
American Sinteel Corp.
Asco Sintering Corp.
Bound Brook Oil-Less Bearing Co.
Ceromet, Inc.
Chicago Powdered Metal Products Co.
Chrysler Corp.
Amplex Div.
Clevite Limited
Compacted Metals Corp.
Dixon Sintaloy, Inc.
Eaton Mfg. Co.
Powdered Metals Div.
Eberhart Steel Products
Powdered Metals Div.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
General Sintering Corp.
Indar Corp.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc.
Rock Mountain Metals Div.
Jet Components, Inc.
Johnson Bronze Co.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Lux Clock Mfg. Co., Inc.
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Midwest Sintered Products Corp.
Moraine Products Div.
General Motors Corp.
Mueller Brass Co.
National Molded Products, Inc.
Norwalk Powdered Metals, Inc.
Pacific Sintered Metals Co.
Parker White Metal Co.
Powdercraft Corp.
Presmet Corp., The
Pure Carbon Co., Inc.
Reese Metal Products Corp.
Sintered Metals, Inc.
Standard Automation Products
Sterling Engineering Corp.
Superior Carbon Products, Inc.
Wakefield Bearing Corp.
Western Sintering Co.
Wickes Corp., The
The United States Graphite Co. Div.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Copper Base

American Powdered Metals, Inc.
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Arrow Sintered Products Co.
Asco Sintering Corp.
Bassick Co., The
Bound Brook Oil-less Bearing Co.
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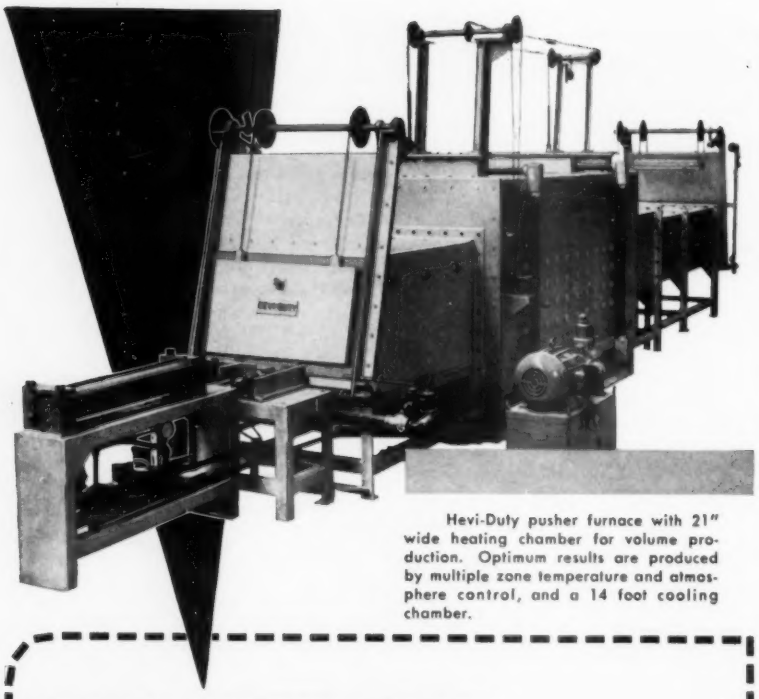
Bunting Brass & Bronze Co., The
Burgess-Norton Mfg. Co.
Carbon City Products Co., Inc.
Ceromet, Inc.
Chicago Powdered Metal Products Co.
Chrysler Corp.
Amplex Div.
Clevite Limited
Compacted Metals Corp.
Dixon Sintaloy, Inc.
Eaton Mfg. Co.
Powdered Metals Div.
Eberhart Steel Products
Powdered Metals Div.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
General Sintering Corp.
Gibson Electric Co.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc.
Rocky Mountain Metals Div.
Jet Components, Inc.
Johnson Bronze Co.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Lux Clock Mfg. Co., Inc.
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Midwest Sintered Products Corp.
Moraine Products Div.
General Motors Corp.
Mueller Brass Co.
National Molded Products, Inc.
Norwalk Powdered Metals, Inc.
Pacific Sintered Metals Co.
Parker White Metal Co.
Picco, Inc.
Powdercraft Corp.
Precision Metal Products Co.
Presmet Corp., The



Hevi-Duty pusher furnace with 21" wide heating chamber for volume production. Optimum results are produced by multiple zone temperature and atmosphere control, and a 14 foot cooling chamber.

HEVI-DUTY

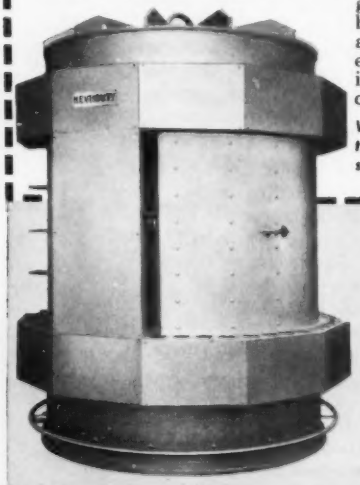
FURNACES FOR SINTERING under a Controlled Atmosphere or Vacuum

CONTINUOUS PRODUCTION FURNACES — Your production sintering requirements can be met by Hevi-Duty pusher or conveyor furnaces; temperatures to 2500°F. Multiple zone temperature control and a variable speed drive will insure uniformly perfect sintered compacts. High temperature electric heating elements reach desired operating temperatures rapidly.

Hevi-Duty exothermic or endothermic atmosphere generators provide the range of gases necessary for sintering.

VACUUM FURNACES — Hevi-Duty pit or bell type double pump vacuum furnaces provide temperatures to 2100°F. Vacuum sintered parts show greater homogeneity and density, and better ductility than those conventionally sintered. This method is often less expensive and the elimination of gas inclusions reduces mechanical or physical defects.

Write for Bulletins 357 and 557 to determine the Hevi-Duty furnace best suited for your sintering requirements.



Hevi-Duty bell type double pump vacuum furnace for sintering at 2100°F. Standard pit or bell type vacuum furnaces are available with uniform working zones up to 54" in diameter by 144" high.

HEVI-DUTY ELECTRIC COMPANY

MILWAUKEE 1, WISCONSIN

Heat Treating Furnaces... Electric Exclusively

Dry Type Transformers *Constant Current Regulators*

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Sterling Engineering Corp.
Superior Carbon Products, Inc.
Symmco, Inc.
Wakefield Bearing Corp.
Western Sintering Co.
Wickes Corp., The
The United States Graphite Co. Div.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Filters

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Kwikset Powdered Metal Products
Metal Ceramics
Micro Metallic Corp.
Powdercraft Corp.
St. Marys Carbon Co.

Iron Base, Controlled Porosity

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Powdered Metal Parts Div.
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American Sinteel Corp.
Arrow Sintered Products Co.
Asco Sintering Corp.
Bassick Co., The
Bound Brook Oil-Less Bearing Co.
Brockway Pressed Metals, Inc.
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Chicago Powdered Metal Products Co.
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Amplex Div.
Clevite Limited
Compacted Metals Corp.
Dixon Sintaloy, Inc.
Eaton Mfg. Co.
Powdered Metals Div.
Eberhart Steel Products
Powdered Metals Div.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
Ford Motor Co.
Accessory Div.
General Sintering Corp.
Indar Corp.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc.
Rocky Mountain Metals Div.
Jet Components, Inc.
Johnson Bronze Co.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Link-Belt Co.
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Moraine Products Div.
General Motors Corp.
Mueller Brass Co.
National Molded Products, Inc.
National Moldite Co.

Norwalk Powdered Metals, Inc.
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Parker White Metal Co.
Picco, Inc.
Powdercraft Corp.
Precision Metal Products Co.
Presmet Corp., The
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Sintered Metals, Inc.
Standard Automation Products
Sterling Engineering Corp.
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Technametals, Inc.
Wakefield Bearing Corp.
Western Sintering Co.
Wickes Corp., The
The United States Graphite Co. Div.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Iron Base, High Density, Copper Free
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Asco Sintering Corp.
Bassick Co., The
Bound Brook Oil-less Bearing Co.
Brockway Pressed Metals, Inc.
Bunting Brass & Bronze Co., The
Burgess-Norton Mfg. Co.
Carbon City Products Co., Inc.
Ceromet, Inc.
Chicago Powdered Metal Products Co.
Chrysler Corp.
Amplex Div.
Clevite Limited
Compacted Metals Corp.
Dixon Sintaloy, Inc.
Eaton Mfg. Co.
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Powdered Metals Div.
Engineered Plastics, Inc.
American Sinterings Div.
Ferro Powdered Metals
General Sintering Corp.
Globe Industries, Inc.
Supermet Div.
Indar Corp.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc.
Rocky Mountain Metals Div.
Jet Components, Inc.
Johnson Bronze Co.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Lux Clock Mfg. Co., Inc.
P. R. Mallory & Co., Inc.
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Moraine Products Div.
General Motors Corp.
Mueller Brass Co.
National Moldite Co.
Norwalk Powdered Metals, Inc.
Pacific Sintered Metals Co.
Parker White Metal Co.
Picco, Inc.
Powdercraft Corp.
Presmet Corp., The
Reese Metal Products Corp.
St. Marys Carbon Co.
Sintered Metals, Inc.
Standard Automation Products
Sterling Engineering Corp.
Superior Carbon Products, Inc.
Technametals, Inc.
Wakefield Bearing Corp.
Western Sintering Co.
Wickes Corp., The
The United States Graphite Co. Div.

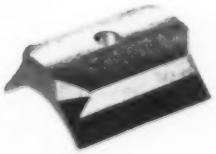
Iron Base, Infiltrated
Allied Products Corp.
Powdered Metal Parts Div.
American Powdered Metals, Inc.
American Sinteel Corp.
Arrow Sintered Products Co.
Asco Sintering Corp.
Bassick Co., The
Bound Brook Oil-less Bearing Co.
Bunting Brass & Bronze Co., The
Burgess-Norton Mfg. Co.
Carbon City Products Co., Inc.
Ceromet, Inc.
Chicago Powdered Metal Products Co.
Chrysler Corp.
Amplex Div.
Clevite Limited
Compacted Metals Corp.

APM

Adaptability to Application

Precision Tolerances

Metallurgically Correct



American Powdered Metals, Inc.

NORTH HAVEN, CONN.

★ BEARINGS ★ POWDERED METAL PARTS

— OUR BUSINESS IS OUR REPUTATION —
LET OUR ENGINEERS SERVE YOU FOR THE
FINEST IN POWDERED METAL PARTS

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American Sinterings Div.
Ferro Powdered Metals
General Sintering Corp.
Indar Corp.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc.
Rocky Mountain Metals Div.
Jet Components, Inc.
Johnson Bronze Co.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Lux Clock Mfg. Co., Inc.
Merriman Bros., Inc.
Metal Ceramics
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Moraine Products Div.
General Motors Corp.
Mueller Brass Co.
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Norwalk Powdered Metals, Inc.
Pacific Sintered Metals Co.
Parker White Metal Co.
Picco, Inc.
Powder Metal Products, Inc.
Powdercraft Corp.
Presmet Corp., The
Reese Metal Products Corp.
St. Marys Carbon Co.
Sintered Metals, Inc.
Standard Automation Products
Sterling Engineering Corp.
Superior Carbon Products, Inc.
Technametals, Inc.
Wakefield Bearing Corp.
Western Sintering Co.
Wickes Corp., The
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Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Nickel Silver

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Bound Brook Oil-less Bearing Co.
Burgess-Norton Mfg. Co.
Ceromet, Inc.
Chicago Powdered Metal Products Co.
Chrysler Corp.
Amplex Div.
Compacted Metals Corp.
Dixon Sintaloy, Inc.
Eberhart Steel Products
Powdered Metals Div.
Engineered Plastics, Inc.
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Ferro Powdered Metals
General Sintering Corp.
Indar Corp.
International Powder Metallurgy Co., Inc.
International Powder Metallurgy Co., Inc.
Rocky Mountain Metals Div.
Jet Components, Inc.
Keystone Carbon Co.
Kwikset Powdered Metal Products
Lux Clock Mfg. Co., Inc.
Merriman Bros., Inc.
Metal Ceramics
Metal Powder Products, Inc.
Midwest Sintered Products Corp.
National Molded Products, Inc.
Norwalk Powdered Metals, Inc.
Pacific Sintered Metals Co.
Parker White Metal Co.
Powdercraft Corp.
Presmet Corp., The
Reese Metal Products Corp.
St. Marys Carbon Co.
Sintered Metals, Inc.
Standard Automation Products
Sterling Engineering Corp.
Superior Carbon Products, Inc.
Wakefield Bearing Corp.
Western Sintering Co.
Wickes Corp., The
The United States Graphite Co. Div.
Yale & Towne Mfg. Co., The
Powdered Metal Products Div.

Stainless Steel

American Sinteel Corp.
Chrysler Corp.
Amplex Div.
Dixon Sintaloy, Inc.
Engineered Plastics, Inc.
American Sinterings Div.
Globe Industries, Inc.
Supermet Div.
Keystone Carbon Co.
Wakefield Bearing Corp.

EQUIPMENT SUPPLIERS

DIES AND TOOLS

Adamas Carbide Corp.
Allegheny Ludlum Steel Corp.
Carmet Div.
Champion Tool & Die Co.
Cleveland Grinding Machine Co., The
Cleveland Tool & Die Co.
Arthur Colton Co.
Curtis Carbide Die Co.
Diecraft Tool Co.
Elizabeth Carbide Die Co., Inc.
Firth Sterling, Inc.
General Electric Co.
Metallurgical Products Dept.
Kennametal, Inc.
Major Gauge & Tool Co.
Micro-Carbide Tool & Die Co., Inc.
Monarch Tool & Gauge Co.
National Carbide Die Co.
National Diamond Laboratory
John E. Skach Tool Co.
F. J. Stokes Corp.
Tungsten Alloy Mfg. Co., Inc.
Union Wire Die Corp.
Vanadium-Alloys Steel Co.
Vascaloy-Ramet Corp.
Welded Carbide Tool Co., Inc.

FURNACES, ELECTRIC

Abbot Corp.
Ajax Electrothermic Corp.
Continental Industrial Engineers, Inc.
Electric Furnace Co., The
Falcon Equipment Co.
Ferguson Equipment Corp.
Gas Machinery Co., The
General Electric Co.
Apparatus Sales Div.
Haller, Inc.
C. I. Hayes, Inc.
Hevi-Duty Electric Co.
Holcroft & Co.
Leeds & Northrup Co.
Lindberg Engineering Co.
Lithium Co., The
Mallory-Schwarzkopf Metals, Inc.
Mannesmann-Meer Engrg. & Construction Co., Inc.
Pereny Equipment Co.
Posey Iron Works, Inc.
Industrial Heating Div.
Sargeant & Wilbur, Inc.
Sentry Co., The
Sunbeam Corp.
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Surface Combustion Corp.
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Westinghouse Electric Corp.
Industrial Heating Div.

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(vacuum)
Eclipse Fuel Engineering Co.
Electric Furnace Co., The
Ferguson Equipment Corp.
Gas Machinery Co., The
Holcroft & Co.
Leeds & Northrup Co.
Lindberg Engineering Co.
Lithium Co., The
Posey Iron Works, Inc.
Industrial Heating Div.
Sargeant & Wilbur, Inc.
Sunbeam Corp.
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Surface Combustion Corp.
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Ammonia Div.
Henry Bower Chemical Mfg. Co.
Hamler Industries, Inc.

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Eclipse Fuel Engineering Co.
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Ferguson Equipment Corp.

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General Electric Co.
Apparatus Sales Div.
Haller, Inc.
C. I. Hayes, Inc.
Hevi-Duty Electric Co.
Holcroft & Co.
C. M. Kemp Mfg. Co., The
Lindberg Engineering Co.
Lithium Co., The
Sargeant & Wilbur, Inc.
Sunbeam Corp.
Industrial Furnace Div.
Surface Combustion Corp.
Westinghouse Electric Corp.
Industrial Heating Div.

Partially Combusted (Endo-Thermic) Gas

Chicago Powdered Metal Products Co.
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Eclipse Fuel Engineering Co.
Electric Furnace Co., The
Ferguson Equipment Corp.
Gas Machinery Co., The
General Electric Co.
Apparatus Sales Div.
Haller, Inc.
C. I. Hayes, Inc.
Hevi-Duty Electric Co.
Holcroft & Co.
Lindberg Engineering Co.
Lithium Co., The
Sargeant & Wilbur, Inc.
Sunbeam Corp.
Industrial Furnace Div.
Surface Combustion Corp.
Westinghouse Electric Corp.
Industrial Heating Div.

Dissociated Ammonia

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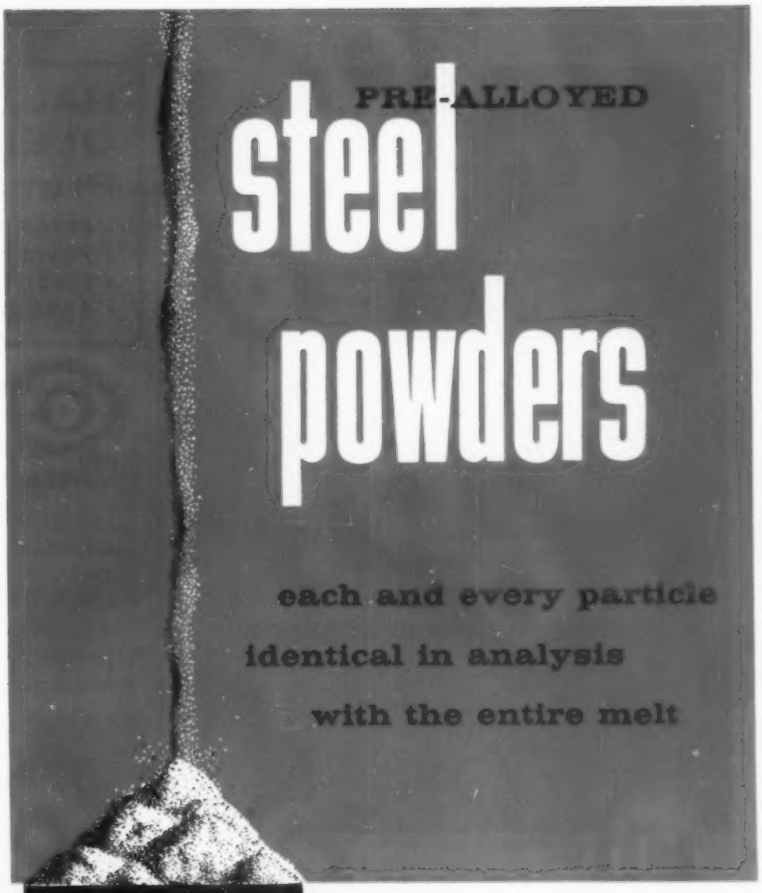
Continental Industrial Engineers, Inc.
Drever Co.
Eclipse Fuel Engineering Co.
Electric Furnace Co., The
General Electric Co.
Apparatus Sales Div.
Haller, Inc.
C. I. Hayes, Inc.
Hevi-Duty Electric Co.
Lindberg Engineering Co.
Lithium Co., The
Sargeant & Wilbur, Inc.
Sunbeam Corp.
Industrial Furnace Div.
Surface Combustion Corp.
Westinghouse Electric Corp.
Industrial Heating Div.

Liquid Hydrocarbon Decomposition

Continental Industrial Engineers, Inc.
Hevi-Duty Electric Co.
Lindberg Engineering Co.
Lithium Co., The
Sunbeam Corp.
Industrial Furnace Div.

IMPREGNATION EQUIPMENT FOR SEALING POROUS PARTS

American Metaseal Mfg. Corp.



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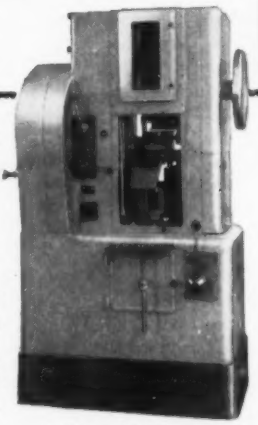

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Imprex Div.

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Sun Chemical Corp.
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Baker Perkins, Inc.
Capitol Products Corp.
Read Standard Div.
Cleveland Mixer Co., The
J. H. Day Co. Div., The
Cleveland Automatic Machine Co., The

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Mercer-Robinson Co., Inc.
National Engineering Co.
Simpson Mix Muller Div.
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Denison Engineering Div.
American Steel Foundries
Elmes Engineering Division

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Baldwin-Lima-Hamilton Corp.
Loewy-Hydropress Div.
E. W. Bliss Co.
Clifton Hydraulic Press Co.
Arthur Colton Co.

Haller, Inc.
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Kux Machine Co.
Lake Erie Machinery Corp.
Logan Engineering Co.
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(laboratory)
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Oliver Corp., The
A. B. Farquhar Div.
Standard Machinery Div.
F. J. Stokes Corp.

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Arthur Colton Co.
Haller, Inc.
A. Johnson & Co., Inc.
Johnson Machine & Press Corp.
Div. of Bontrager Corp.
Kux Machine Co.
Mannesmann-Meer Engrg. & Construction Co., Inc.
Mansol Ceramic Co.
Minster Machine Co., The
Standard Machinery Div.
F. J. Stokes Corp.

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Leeds & Northrup Co.
Minneapolis-Honeywell Regulator Co.
Pyrometer Instrument Co.
Arklay S. Richards Co., Inc.
Service Associated, Inc.
West Instrument Corp.

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Wheelco Div.
R. A. Ekstrom Co.
Illinois Testing Laboratories, Inc.
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R. A. Ekstrom Co.
General Electric Co.
Apparatus Sales Div.
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Illinois Testing Laboratories, Inc.
Minneapolis-Honeywell Regulator Co.
Pyrometer Instrument Co., Inc.
Simpson Electric Co.
West Instrument Corp.

Optical Pyrometers

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Leeds & Northrup Co.
Minneapolis-Honeywell Regulator Co.
Pyrometer Instrument Co.

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Barber-Colman Co.
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General Electric Co.
Apparatus Sales Div.
Leeds & Northrup Co.
Minneapolis-Honeywell Regulator Co.
Pyrometer Instrument Co.
West Instrument Corp.
Winslow Co., Inc., The

Program Controllers

Barber-Colman Co.
Wheelco Div.
General Electric Co.
Apparatus Sales Div.
Leeds & Northrup Co.
Minneapolis-Honeywell Regulator Co.
West Instrument Corp.
Winslow Co., Inc., The

Thermocouples

Barber-Colman Co.
Wheelco Div.
R. A. Ekstrom Co.
General Electric Co.
Apparatus Sales Div.
Claud S. Gordon Co.
C. I. Hayes, Inc.
Illinois Testing Laboratories, Inc.
Leeds & Northrup Co.
Minneapolis-Honeywell Regulator Co.
Pyrometer Instrument Co.
Arklay S. Richards Co., Inc.
Service Associated, Inc.
Simpson Electric Co.
West Instrument Corp.
Winslow Co., Inc., The

Thermocouple Failure Protective Devices

Barber-Colman Co.
Wheelco Div.
R. A. Ekstrom Co.
Claud S. Gordon Co.
Illinois Testing Laboratories, Inc.
Leeds & Northrup Co.
Minneapolis-Honeywell Regulator Co.
Service Associated, Inc.
West Instrument Corp.

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R. A. Ekstrom Co.
General Electric Co.
Apparatus Sales Div.
Claud S. Gordon Co.
Illinois Testing Laboratories, Inc.
Leeds & Northrup Co.
Minneapolis-Honeywell Regulator Co.
Morganite, Inc.
Arklay S. Richards Co., Inc.
Service Associated, Inc.
West Instrument Corp.

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Cleveland Automatic Machine Co., The
Exolon Co., The
B. F. Gump Co.

Mercer-Robinson Co., Inc.
F. J. Stokes Corp.
Sturtevant Mill Co.
Taunton Engineering Works
W. S. Tyler Co., The

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Metals Disintegrating Co., Inc.
Reade Mfg. Co., Inc.
Reynolds Metals Co.
U. S. Bronze Powder Works, Inc.

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80-20

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Charles Hardy, Inc.
Malone Metal Powders, Inc.
Metals Disintegrating Co., Inc.
New Jersey Zinc Co., The
U. S. Bronze Powder Works, Inc.

70-30

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Greenback Industries, Inc.
Charles Hardy, Inc.
Malone Metal Powders, Inc.
Metals Disintegrating Co., Inc.
New Jersey Zinc Co., The

60-40

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Greenback Industries, Inc.
Charles Hardy, Inc.
Malone Metal Powders, Inc.
Metals Disintegrating Co., Inc.
New Jersey Zinc Co., The

COPPER

Atomized

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Greenback Industries, Inc.
Charles Hardy, Inc.
Malone Metal Powders, Inc.
New Jersey Zinc Co., The
U. S. Bronze Powder Works, Inc.

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Belmont Smelting & Refining Works, Inc.
Charles Hardy, Inc.

Reduced

Federal-Mogul-Bower Bearings, Inc. (copper-base alloys)
Whitaker Metals Corp.

Sponge

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Glidden Co., The Chemicals-Pigments-Metals Div.
Greenback Industries, Inc.

IRON

Atomized

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Easton Metal Powder Co., Inc.
Ferrum Limited
Foote Mineral Co.
Charles Hardy, Inc.
Hoeganaes Sponge Iron Corp.
Metal Powders Limited

Carbonyl

General Aniline & Film Corp. Antara Chemicals Div.
Charles Hardy, Inc.
International Nickel Co., The
National Moldite Co.

Decarburized Cast Iron

Foote Mineral Co.
Charles Hardy, Inc.

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Sponge

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Ferrum Limited
Charles Hardy, Inc.
Hoeganaes Sponge Iron Corp.
Metal Powders Limited
Micronized Metals, Inc.
National Moldite Co.
National - U. S. Radiator Corp.
Plastic Metals Div.

LEAD

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NICKEL

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Foote Mineral Co.
Charles Hardy, Inc.
International Nickel Co., The
Kulite Tungsten Co.
Metals Disintegrating Co., Inc.
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Powder Metals Research
Pyron Corp.
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Hoeganaes Sponge Iron Corp.
Pyron Corp.
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Charles Hardy, Inc.
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Micronized Metals, Inc.
Charles Hardy, Inc.
Metal Powders Limited
Vanadium-Alloys Steel Co.

Stainless

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Uniworld Research Corp. of America
Vanadium-Alloys Steel Co.

TIN

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Belmont Smelting & Refining Works, Inc.
Glidden Co., The
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Greenback Industries, Inc.
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Metals Disintegrating Co., Inc.
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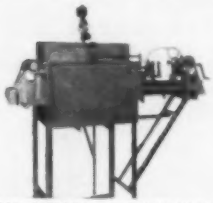

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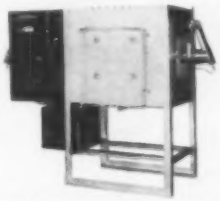

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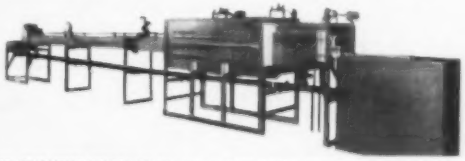

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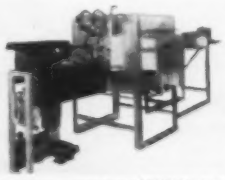

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MERRIMAN BROS., INC.

185 Amory Street Boston 30, Mass.

REPRESENTATIVES IN PRINCIPAL CITIES

4324 W. Florissant Ave.
St. Louis, Missouri

33 University Ave.
Rochester, New York

P. O. Box 181
West Concord, Mass.

(tungsten, molybdenum, tantalum, columbium)

Firth Sterling, Inc.
(tantalum carbide powder, tungsten powder, tungsten carbide powder, titanium carbide powder)

Foote Mineral Co.
(chromium metal powder, electrolytic manganese metal, zirconium metal powder)

Hoeganaes Sponge Iron Corp.
(custom blended powders)

Kulite Tungsten Co.
(tungsten, molybdenum, cobalt)

Metal Hydrides, Inc.
(70 Cr - 30 Ni, 50 Cr - 50 Ni, 30 Cr - 70 Ni)

Metal Powders Limited
(8% copper, 3% nickel)

National - U. S. Radiator Corp.
Plastic Metals Div.
(iron-aluminum, iron-titanium)

New Jersey Zinc Co., The
(bronzes)

Powder Metals Research
(cobalt, tungsten carbide, tungsten alloy)

Sherritt Gordon Mines Ltd.
(cobalt, cobalt-nickel)

Shieldalloy Corp.
(tantalum carbide, columbium carbide, tungsten-titanium carbide, titanium carbide, chromium carbide)

United International Research, Inc.
(titanium, titanium alloy powders)

Of the 9 major powder metallurgy grades of

HOEGANAES SPONGE IRON POWDERS

-- your selection of a specific grade
enables you to match the powder to the part

MH-100
Ancor 80
Ancor 816
Ancor MH-100
Ancor MH-100S
Ancor MH-1021
Ancor EP 10-24
Ancor MH-1010
Ancor MH-2010

Gone are the days when a metal parts fabricator had no choice but to match the part to a limited choice of powder grades. *Now, you can match the powder to the part.* And choose that grade that gives you the best combination of properties to meet your exacting specifications.

Today, nine major powder metallurgy grades of Hoeganaes Sponge Iron Powders give you that desirable wide selection range.

In addition, the Hoeganaes "Custom Blending" Service extends this selection range *to guarantee that the powder is matched to the part.*

Hoeganaes Engineering Specialists are prepared to cooperate with you towards solving this grade-selection phase . . . and are available to aid you in your solutions of other powder metallurgy problems.

HSIC
HOEGANAES SPONGE IRON CORPORATION
RIVERTON, NEW JERSEY

SALES REPRESENTATIVES IN PRINCIPAL CITIES: Birmingham, Chicago, Cincinnati, Cleveland (Factoria), Edmonton (Alberta, Canada), Los Angeles, Minneapolis, New England (Illinois, N.Y.), Philadelphia (Riverton, N. J.), Pittsburgh, San Francisco, St. Louis

For more information circle No. 50 on the Reader Service Card

Circle No. 71 on the Reader Service Card

Dies & Tools for powdered metal parts

STEEL OR CARBIDE

Gears
Cams
Splines
Bushings
Bearings
and
Special Parts

MAJOR
GAUGE AND TOOL COMPANY
26817 W. 7 MILE RD. • DETROIT 40, MICH.
Telephone KE. 1-3311

Circle No. 114 on the Reader Service Card

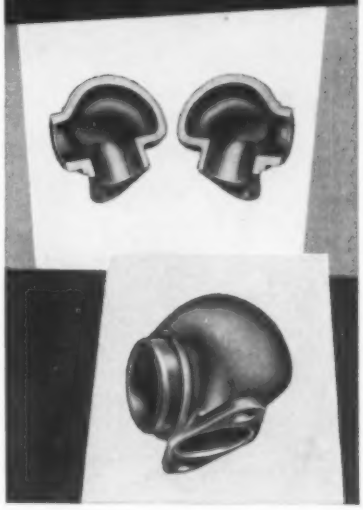
STERLING
Powdered Metal Products

Production, Short Run and Experimental Precision Bearings and Parts of Bronze, Brass, Iron, etc.

For Quality and Service write to:

Sterling Engineering Corp.
P.O. 559 — WINSTED, CONN.

two halves *don't* make a hole!



. . . *with* INVESTMENT CASTING *it's made in one piece.*

We don't tackle casting problems halfway at Hitchiner.

Here's a cross section where the inside dimensions are greater than the holes. Originally made in sections and assembled — now the whole unit is precision cast and is lighter and stronger.

Where application requirements demand that a part be of intricate shape; of unusual contour, of fine detail, or of metals difficult or impossible to machine — investment casting provides an efficient and economical solution.

Only your production costs are cut in half when you utilize the efficiency of investment casting. You save time and plenty of labor. And . . . you'll have a wide selection of metals; the non-ferrous group, the carbon and low alloy steels, the hard-to-form, hard to machine high alloy steels . . . even cobalt base alloys.

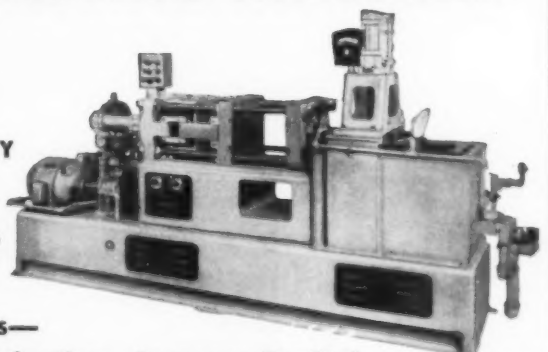
If you use metal in your product, investigate the possibilities of investment casting. Write us today for our free brochure.

HITCHINER
MANUFACTURING COMPANY, INC.
MILFORD 11, NEW HAMPSHIRE
Representatives in Principal Cities

HERE IT IS! A LOW COST — HIGH SPEED DIE CASTING MACHINE

UP TO FULL
3 lb.
SHOT CAPACITY

Over 1300 Free Cycles Per Hour!



Reduce Costs—
Speed up Production—Increase Profits!

Now you can run high grade castings, up to 3 lbs., at high speeds and low operating costs. Actual tests operating 8 hours a day, 5 days a week, show total cost of gas and electricity of ONLY 17c PER HOUR!

Outstanding features include — all steel welded construction — automatic electric cycling at high speed — 17¾ x 17¾" die platens — 6½" die stroke — highest grade controls and valves mounted for easy maintenance and accessability — a complete package with self contained unit.

Available in Air or Hydraulically operated plunger gooseneck type for zinc, tin or lead, or, cold chamber type for aluminum, brass and magnesium.

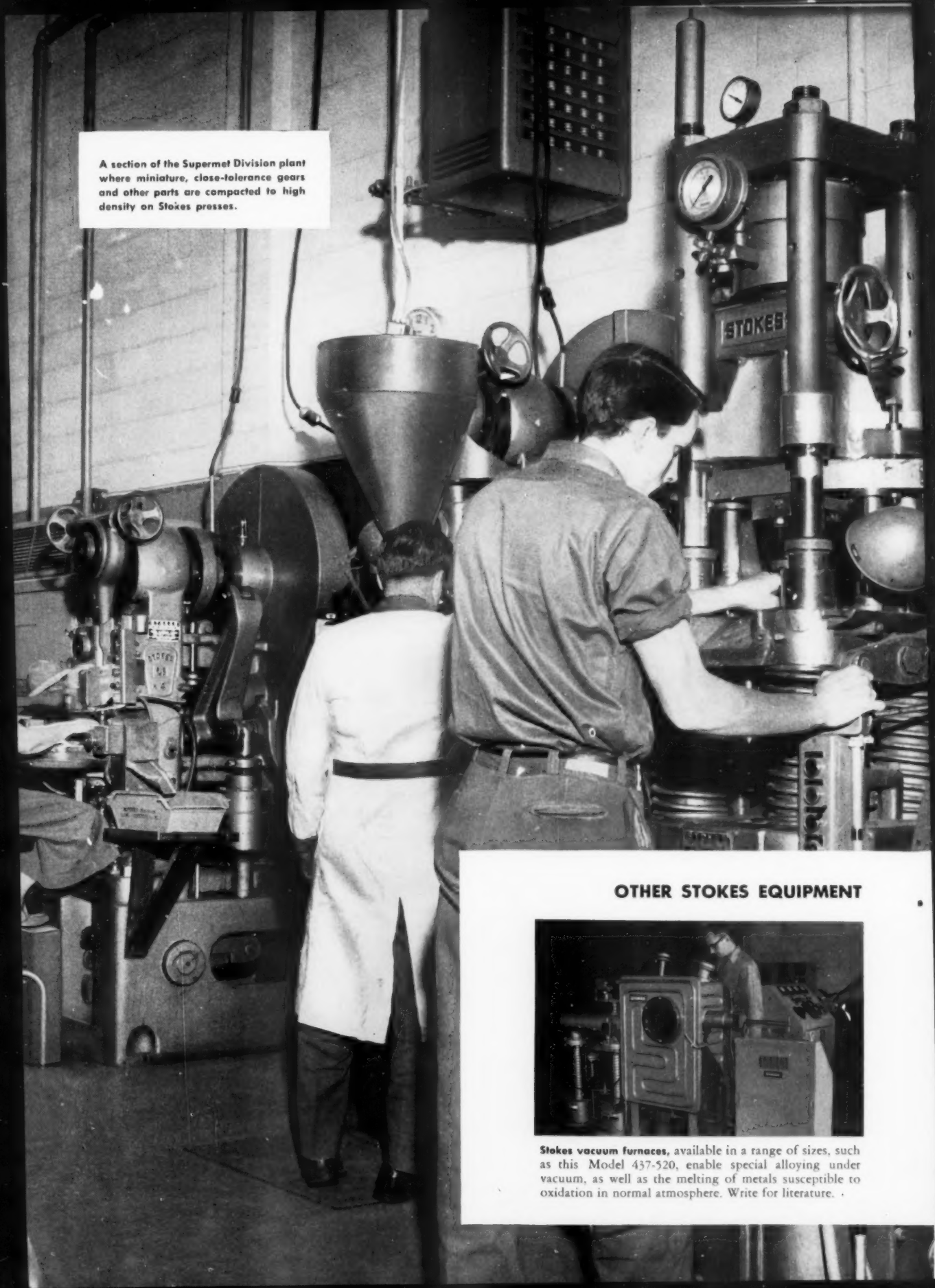
Write for Free illustrated folder containing complete data on all models.

AMERICAN DIE CASTING MACHINERY CO.
1762 W. Winona St., Chicago 40, Ill. PHONE: LOngbeach 1-7118

Users of
American Die Casting Machines
Ajax Die Casting Co.
Chandler Mfg. Co.
General Motors Corp.
Rochester Prod. Div.
Helfrich Die Casting Co.
Newton-New Haven
and others

For more information circle No. 8 on the Reader Service Card

Circle No. 49 on the Reader Service Card

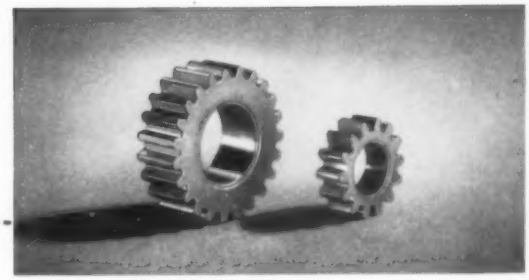


A section of the Supermet Division plant where miniature, close-tolerance gears and other parts are compacted to high density on Stokes presses.

OTHER STOKES EQUIPMENT

Stokes vacuum furnaces, available in a range of sizes, such as this Model 437-520, enable special alloying under vacuum, as well as the melting of metals susceptible to oxidation in normal atmosphere. Write for literature.

Enlarged 2½ times...the smaller steel gear is made to Commercial Grade 4 specifications, the larger one is made to Precision Grade 1 specifications. Both are pressed to 95% of theoretical density, are hardened to 30N64-69 specifications, and have tensile ratings of 130,000 psi.



Close-tolerance, powder metal parts pressed to high density at Supermet

Globe Industries, Inc., is the world's largest manufacturer of miniature precision motors. The Supermet Division, Dayton, Ohio, is a modern well-equipped powder metal pressing plant...supplies high-strength, close-tolerance gears for a variety of Globe's needs, as well as parts for other customers. When production of these precision parts was changed to powder metal pressing, substantial cost reductions were effected.

The Stokes equipment at Supermet includes one Model 294, two Model R-4's and two Model F-4's . . . with a third F-4 now on order. Some have already seen substantial service, yet all are regarded as "dependable machinery with very little down-time."

Typical of the Stokes line of equipment for powder metal pressing is the Model 640 . . . embodying such features as independent press adjustments and direct-reading calibrations, making it exceptionally easy to set up and to control from one centralized location. It, too, is designed for close-tolerance tooling and is uniquely suited for multi-level die work.

If you are now making metal parts by conventional machining methods, it will pay you to investigate the powder metal process and to call on the Stokes Advisory Service. This complete service can assist you in determining production costs . . . can handle complete laboratory production for sampling . . . includes design and fabrication of punches and dies, and recommendations for types of equipment. Write for complete information and literature.

Powder Metal Press Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

FOR METAL-WORKING PLANTS

Vacuum plating, in Stokes Vacuum Metallizers, produces a bright, attractive, metallic finish at far lower cost than electroplating. A complete line of self-contained, centrally controlled systems is available. Write for literature.

STOKES

For more information circle No. 94 on the Reader Service Card

Finished to Print Specifications
No Scrap Metal Loss • Lower Final Cost

Eaton supplies finished parts to specification, with all of the secondary machining operations completed. This saves time and cost—reduces inventory investment. Our modern conveyorized plant is equipped with a balanced line of automatic presses having capacities up to 500 tons—capable of handling all types of Powdered Metal parts in a wide range of sizes. In addition, extensive up-to-date machine shop facilities enable Eaton to furnish interesting quotations on completely finished, ready-to-use parts.

- ★ **Powdered Metal Parts of Iron, Steel, and Stainless Steel**
- ★ **Structural Parts of Bronze and Brass**
- ★ **Oil Impregnated Porous Bronze and Iron Bearings**
- ★ **Copper Infiltrated Iron Parts**
- ★ **Case-Hardened and Heat-Treated Parts**

Consult with our Engineers on Your Powdered Metal Requirements.

EATON

POWDERED METALS DIVISION
MANUFACTURING COMPANY
COLDWATER, MICHIGAN

For more information circle No. 37 on the Reader Service Card

ADVANCES *continued from page 68*

P.R. MALLORY & CO. Inc. MALLORY

P. R. MALLORY & CO.

The development of powders and processes generally known as "Steelmet" may be a major break-through for powder metallurgy.

With this process it appears feasible to produce many structural parts from metal powders that have not been possible before. With the new powders and processing, parts that are at least 95% as dense as wrought parts of the same general composition can be made.

DREVER COMPANY

We have noted several developments in the powder metallurgy industry. The first is the mass production of powder by the chemical precipitate method. This has necessitated the development of furnaces for sintering briquettes where the capacity of the furnace is in tons-per-hour rather than pounds-per-hour as has previously been the case.

A second significant development is in the change of thinking about the length of the burn-off chamber. A ratio of ½ to 1 has, in the past, been considered adequate. The trend is now to a 1 to 1 ratio. The length of the burn-off chamber has been doubled. This change has resulted in a far superior end-product, especially in the brass, bronze and copper fields.

METAL POWDERS, LTD.

A significant development is the new high sulfur iron powder. Such a powder imparts good machining qualities to parts pressed from it. The sulfur content is not an additive to the iron powder but is alloyed with the iron. This lessens the degree of contamination in sintering furnaces.

Another development of significance is the availability of alloyed powders, imported from England, that have not yet been regularly or successfully manufactured here.

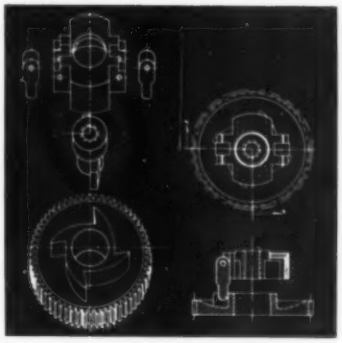
HALLER, INC.

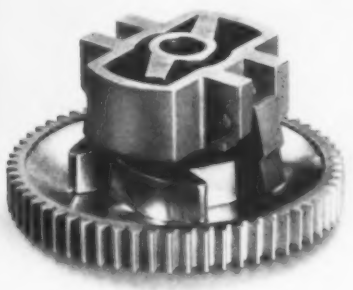
As more is learned about the mechanics of the sintering process, furnace design is modified to assure the best possible sintering conditions. The separation of the burn-off zone from the sintering zone reduces atmosphere contamination to a marked extent.

Separation of the sintering zone into two separately controlled parts allows control of the rate of heating as well as the length of dwell at maximum temperature.

A controlled cooling zone has led to better parts and fewer rejects by eliminating the thermal shock brought on by passing from the high-temperature zone directly into a water-cooled zone. Warping, distortion, and internal stresses are all greatly reduced in this manner.

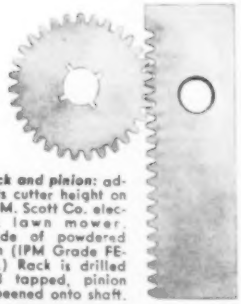
from the design to the manufactured product





Clutch: high-strength unit absorbs starting torque on powered lawn mower. Redesigned unit has threaded shaft adapter to fit inside pawl carrier, the space between is filled with rubber. Parts are copper-infiltrated iron powder (IPM Grade IC-752) to meet SAE spec #7. Tensile strength: about 90,000 psi.

If you make powered lawn mowers you'll recognize these trouble sources. Whatever you make, you ought to recognize the key to best use of powder metallurgy: ***design that fits the process.*** Large part or small, tough job or easy, International Powder Metallurgy Company will produce your powder metal parts economically only after working with your engineering dept. to make sure you get the most this manufacturing method has to offer. You'll probably find your product benefits, along with your cost picture.



Rack and pinion: adjusts cutter height on O. M. Scott Co. electric lawn mower. Made of powdered iron (IPM Grade FE-973.) Rack is drilled and tapped, pinion is peened onto shaft.

FREE handbook for powder metallurgy engineers. Ask for your copy.

IPM **INTERNATIONAL POWDER METALLURGY CO.**

439 W. MAIN STREET • RIDGWAY, PENNSYLVANIA

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How Glidden can help you produce better Metal Powder Parts...

Whether you are interested in improving the operation of an existing metal powder parts department, or desire to establish a new parts department, Glidden can help you.

Glidden not only offers the helpful assistance of its metal powders lab and trained metallurgists, but can also supply you with RESISTOX Metal Powders that permit faster production of precision parts with greatly improved finish, appearance and performance characteristics. And Glidden has the facilities to produce up to 30,000 pounds of RESISTOX Metal Powders in one batch—an important factor in complete uniformity of mass-produced parts.

Why not take a careful look at the manufacturing method you are now using. Make certain you are not overlooking the economies, speedier fabrication and superior parts performance you can get by using Glidden RESISTOX Metal Powders. Write on your letterhead for complete details.

THE GLIDDEN COMPANY

Chemicals—Pigments—Metals Division

Baltimore, Maryland • Collinsville, Illinois
Hammond, Indiana • Scranton, Pennsylvania

QUALITY Glidden PRODUCTS

CHEMICALS PIGMENTS METALS

COPPER POWDER • LEAD POWDER • TIN POWDER
CUBOND COPPER BRAZING PASTE • BRASS POWDER • ALLOY POWDER • CUPRIC OXIDE • CUPROUS OXIDE • COPPER PIGMENT • CUPROUS SULPHIDE • FILTER POWDER

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7th annual

POWDER METALLURGY DIRECTORY

SECTION 3
ALPHABETICAL LIST

COMPONENTS FABRICATORS

Adamas Carbide Corp.
Kenilworth, N. J.
(dies and tools, cemented carbides)

Aerovox Corp.
Crowley Div.
1 Central Ave.
West Orange, N. J.
(cores, magnetic materials)

Allied Products Corp.
Powdered Metal Parts Div.
456 E. Cady
Northville, Mich.
(bearings, structural parts, electrical components)

American Brake Shoe Co.
5400 W. 130
Cleveland, O.
(friction materials)

American Powdered Metals, Inc.
7 Philip Place
North Haven, Conn.
(bearings, structural parts, electrical components)

American Sinteel Corp.
1019 Saw Mill River Rd.
Yonkers, N. Y.
(bearings, structural parts, magnetic materials, electrical components)

Arnold Engineering Co., The
P. O. Box G
Marengo, Ill.
(cores, magnetic materials)

Arrow Sintered Products Co.
1900 S. Kostner Ave.
Chicago, Illinois
(bearings, structural parts)

Asco Sintering Corp.
7799 Telegraph Rd.
Los Angeles, Cal.
(bearings, structural parts, magnetic materials, electrical components)

Bassick Co., The
437 Howard Ave.
Bridgeport, Conn.
(bearings, structural parts)

Bound Brook Oil-less Bearing Co.
Bound Brook, N. J.
(bearings, structural parts)

Brockway Pressed Metals, Inc.
921 Clark
Brockway, Pa.
(bearings, structural parts)

Bunting Brass & Bronze Co., The
715 Spencer
Toledo, O.
(bearings, structural parts, electrical components)

Burgess-Norton Mfg. Co.
737 Peyton
Geneva, Ill.
(structural parts)

Carbon City Products Co., Inc.
Ford Road
St. Marys, Pa.
(bearings, structural parts)

Ceromet, Inc.
16233 Gale Ave.
La Puente, Calif.
(bearings, structural parts)

Chicago Powdered Metal Products Co.
9700 Waveland Ave.
Schiller Park, Ill.
bearings, structural parts, electrical components)

Chrysler Corp.
Amplex Div.
P. O. Box 2718
Detroit, Mich.
(bearings, structural parts, magnetic materials, contact materials, friction materials, electrical components)

Clevite Corp.
17000 St. Clair Ave.
Cleveland, O.
(bearings)

Clevite Limited
1177 Talbot Street
St. Thomas, Ont., Can.
(bearings, structural parts, electrical components)

Compacted Metals Corp.
99 Greenwood Ave.
Waukegan, Ill.
(bearings, structural parts, magnetic materials, contact materials, electrical components)

Custom Components, Inc.
P. O. Box 248
Caldwell, N. J.
(cores)

Deva-Metal Corp.
P. O. Box 146
Ridgewood, N. J.
(bearings)

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.
(bearings, structural parts, magnetic materials, electrical components)

Eaton Mfg. Co.
Powdered Metals Div.
325 Jay
Coldwater, Mich.
(bearings, structural parts, cemented carbides, electrical components)

Eberhart Steel Products
Powdered Metals Div.
317 E. Jefferson Blvd.
Mishawaka, Ind.
(structural parts, electrical components)

Engelhard Industries, Inc.
Baker Contact Div.
207 Grant Ave.
East Newark, N. J.
(contact materials)

Engineered Plastics, Inc.
American Sinterings Div.
P. O. Drawer P.
Watertown, Conn.
(bearings, structural parts, cores, magnetic materials, dies and tools, electrical components)

Fansteel Metallurgical Corp.
2200 Sheridan Rd.
North Chicago, Ill.
(contact materials, tungsten, molybdenum, tantalum, columbium)

Federal-Mogul-Bower Bearings, Inc.
Detroit, Mich.
(bearings, copper)

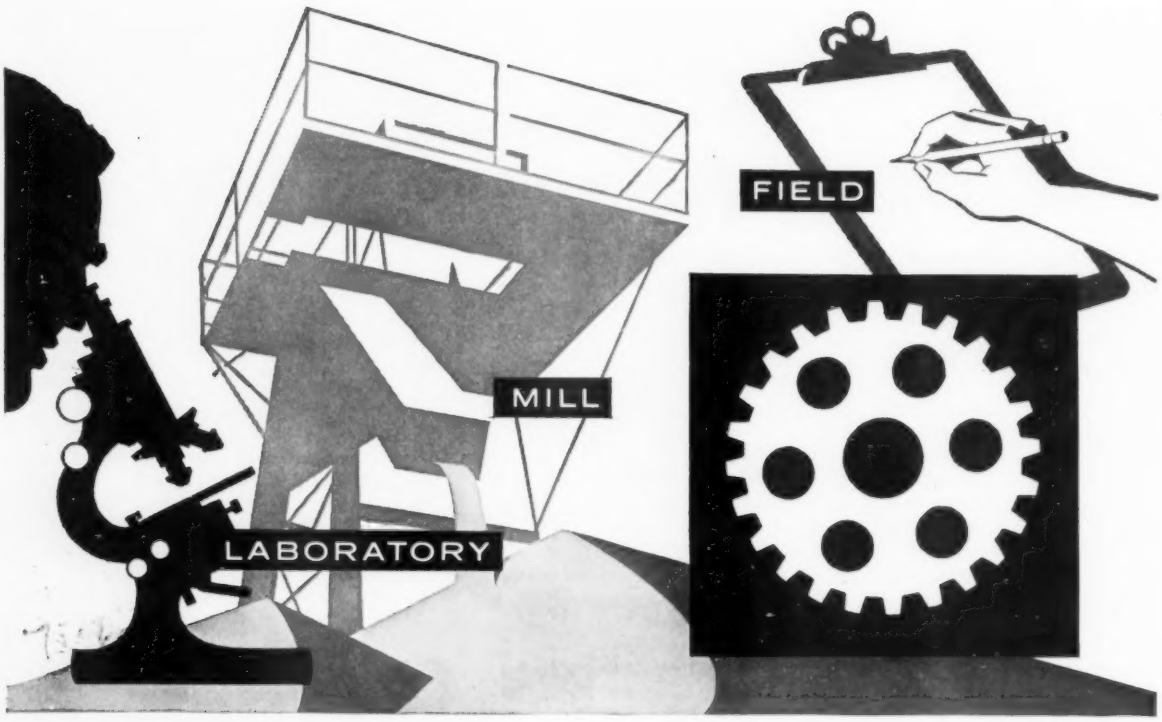
Ferro Powdered Metals
Box 312
Salem, Ind.
(bearings, structural parts, magnetic materials, electrical components)

Ferroxcube Corp. of America
Saugerties, N. Y.
(cores, magnetic materials)

Firth Sterling, Inc.
1330 Forbes St.
Pittsburgh, Pa.
(dies and tools, cemented carbides, other metal powders)

Ford Motor Co.
Accessory Div.
Rawsonville, Plt.
P. O. Box 75
Ypsilanti, Mich.
(bearings, structural parts)

General Aniline & Film Corp.
Antara Chemicals Div.
435 Hudson
New York, N. Y.
(magnetic materials, iron)



REPUBLIC'S 3-STEP METALLURGICAL SERVICE AND $^{c}d_{f}$ IRON POWDERS

Help Solve Design and Fabricating Problems

3-Step Metallurgical Service combines the experience and knowledge of Republic's Field, Mill and Laboratory Metallurgists with the skills of your own engineering and designing staffs. The objective of this service is to help you work out the solutions to problems you may encounter in the design and fabrication of iron powder parts.

The Republic Field Metallurgist studies the problem, right in your own plant. He talks to your designers and engineers, asks questions, finds out what you want iron powder to do. His report goes to the Republic Mill and Laboratory Metallurgists.

These three men discuss the report—pool their combined knowledge of iron powder and steel practice—check it against your problem. Their recommendation, based on solid data, is passed on to your engineers by the Republic Field Metallurgist. He stays on the job, works with your personnel to see that the problem is solved to your satisfaction.

The recommendations of these Republic specialists can help you determine iron powder's suitability to your parts design. Republic's new *Controlled Dimensional Factor* iron powders—Type "G" for growth, Type "N" for normal, Type "S" for shrinkage—can help you reduce fabricating costs and save on expensive die re-working.

Republic's 3-Step Metallurgical Service is free. You can have it by calling your local Republic Steel sales office, or by mailing the coupon.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL

REPUBLIC STEEL CORPORATION
DEPT. PM-3924
1441 REPUBLIC BUILDING
CLEVELAND 1, OHIO

☐ Have a Republic Field Metallurgist call.

☐ Send more information on Iron Powder with CDF.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

For more information circle No. 89 on the Reader Service Card

General Electric Co.
Magnetic Materials Sec.
Edmore, Mich.
(magnetic materials)

General Electric Co.
Metallurgical Products Dept.
11179 E. 8 Mile Rd.
Detroit, Mich.
(dies and tools, magnetic materials, cemented carbides)

General Magnetic Corp.
10001 Erwin
Detroit, Mich.
(magnetic materials)

General Metals Powder Co., The
130 Elinor Ave.
Akron, O.
(friction materials)

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.
(bearings, structural parts, magnetic materials, contact materials, cemented carbides, friction materials, electrical components)

Gibson Electric Co.
Box 547
Delmont, Pa.
(structural parts, contact materials, electrical components)

Globe Industries, Inc.
Supermet Div.
1460 Cincinnati
Dayton, O.
(structural parts, contact materials)

Handy & Harman
82 Fulton
New York, N. Y.
(contact materials)

Indar Corp.
2215 Alvord
Indianapolis, Ind.
(bearings, structural parts, cores, magnetic materials, cemented carbides, electrical components)

Indiana Steel Products Co., The
405 Elm St.
Valparaiso, Ind.
(magnetic materials)

International Powder Metallurgy Co., Inc.
439 W. Main
Ridgway, Pa.
(bearings, structural parts, magnetic materials, electrical components)

International Powder Metallurgy Co., Inc., Rocky Mountain Metals Div.
3200 Century Ave.
Colorado Springs, Colo.
(bearings, structural parts, magnetic materials)

Jet Components, Inc.
3152 San Fernando Rd.
Los Angeles, Cal.
(structural parts, cores, magnetic materials)

Johnson Bronze Co.
500 S. Mill
New Castle, Pa.
(bearings, structural parts)

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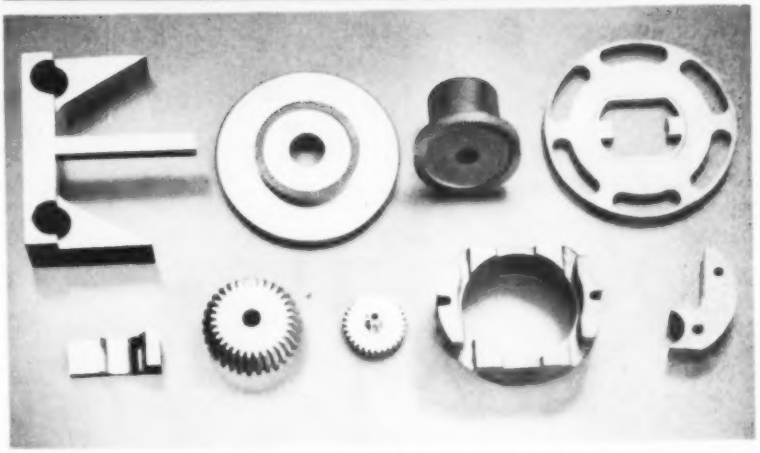
HIGH PRECISION AND HIGH DENSITY PARTS

MEMBER



Write for detailed information. We can save you money on hard-to-machine parts.

American Sinterings
A DIVISION OF ENGINEERED PLASTICS, INC.
WATERTOWN, CONNECTICUT

METAL POWDERS MPL LIMITED

Iron Powders
Steel Powders
Iron Alloy Powders
Flame Cutting Powders

WE ARE NOW PREPARED TO OFFER ALL TYPES OF NON-FERROUS POWDER (EXCEPT COPPER) AND NON-FERROUS ALLOY POWDERS.

Your Inquiries Welcomed

Our representative will be in attendance at the Metal Powder Show.

METAL POWDERS LTD.
73 - 5th AVE. IBERVILLE, QUEBEC
CANADA

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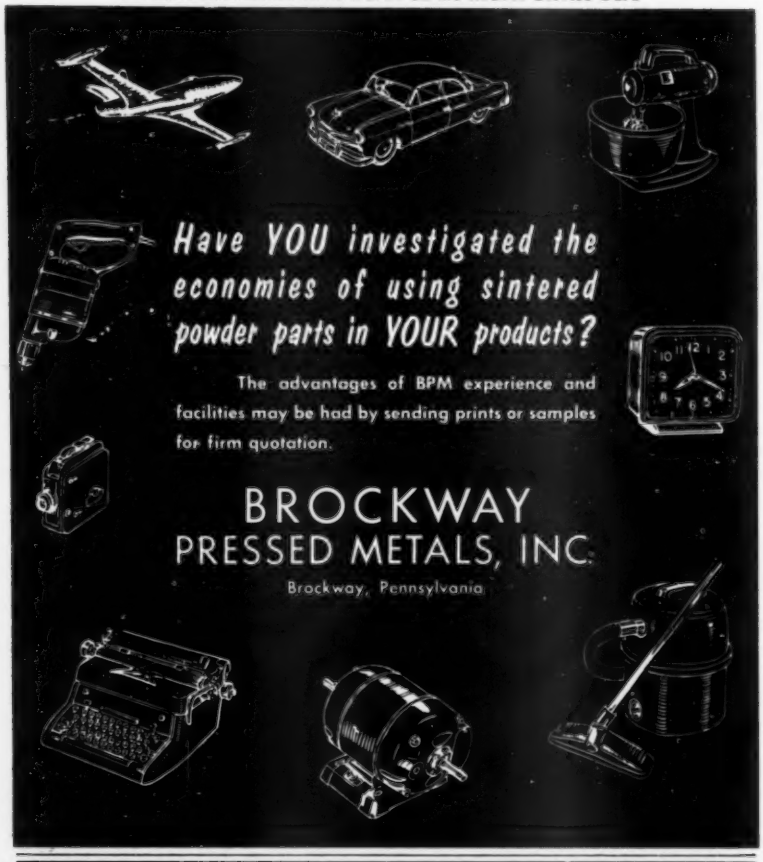
For more information circle No. 26 on the Reader Service Card


Have YOU investigated the economies of using sintered powder parts in YOUR products?
The advantages of BPM experience and facilities may be had by sending prints or samples for firm quotation.
BROCKWAY
PRESSED METALS, INC.
Brockway, Pennsylvania

Serving the die casting industry

TRIM DIES

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Orchard 4-6046 (Suburban Chicago)

For more information circle No. 79 on the Reader Service Card

Kennametal, Inc.
Lloyd Ave.
Latrobe, Pa.
(dies and tools, cemented carbides)

Keystone Carbon Co.
1935 State
St. Marys, Pa.
(bearings, structural parts, magnetic materials, contact materials)

Kulite Tungsten Co.
1040 Hoyt Ave.
Ridgefield, N. J.
(contact materials, nickel)

Kwikset Powdered Metal Products
516 E. Santa Ana
Anaheim, Cal.
(bearings, structural parts, cores, magnetic materials, contact materials, friction materials, electrical components)

Magnetic Core Corp.
P. O. Box 368
Newburgh, N. Y.
(cores)

Magnetics, Inc.
East Butler, Pa.
(cores)

P. R. Mallory & Co., Inc.
3029 E. Washington
Indianapolis, Ind.
(structural parts, contact materials, electrical components)

Mallory-Schwarzkopf Metals, Inc.
320 Yonkers Ave.
Yonkers, N. Y.
(electric furnaces, cemented carbides)

Merriman Bros., Inc.
185 Amory
Boston, Mass.
(bearings, structural parts, magnetic materials, electrical components)

Metal Ceramics
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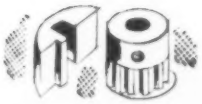

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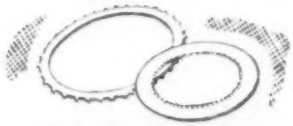

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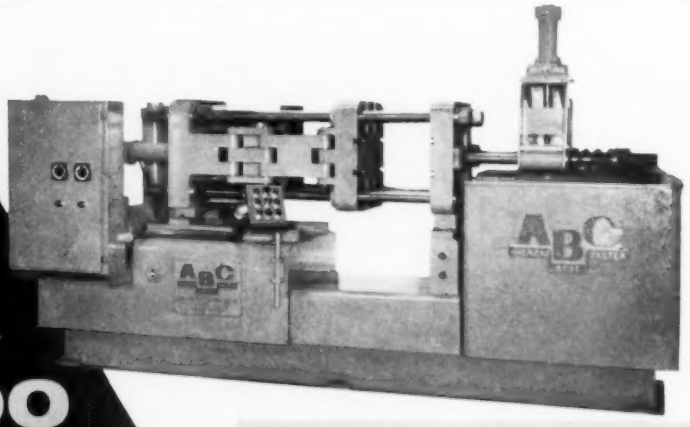

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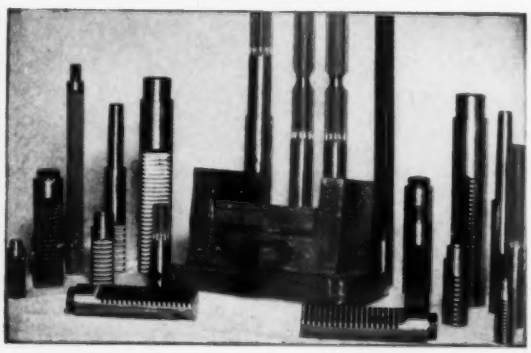

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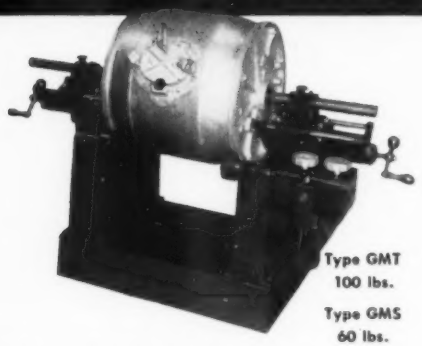


Type GMT 100 lbs.
Type GMS 60 lbs.

With these Detroit Rocking Electric Furnaces, you can melt small quantities of any ferrous or non-ferrous alloy to the required analysis quickly, economically. Indirect arc melting provides accurate heat control plus minimum carbon pickup. Automatic rocking action assures homogeneous alloying, full heat utilization and longer lining life. Electrodes are independently mounted for easy shell interchange. Types GMS and GMT Furnaces are sold complete with transformers, ready for installation. Write today for full information.

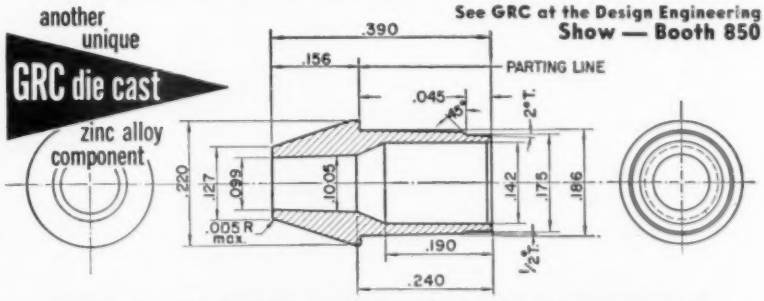
FEMA

DETROIT ELECTRIC FURNACE DIVISION
KUHLMAN ELECTRIC COMPANY
1070 26th St. • BAY CITY, MICHIGAN

Foreign Representatives: in BRAZIL—Equipamentos Industrias, "Eisa" Ltd., Sao Paulo; CHILE, ARGENTINA, PERU and VENEZUELA: M Castellvi Inc., 150 Broadway, New York 7, N. Y.; MEXICO: Cia Proveedora de Industrias, Atenas 32-13, Apartado 27A3, Mexico 6, D F., Mexico; EUROPE, ENGLAND: Birlec, Ltd., Birmingham.

another unique **GRC die cast** zinc alloy component

See GRC at the Design Engineering Show — Booth 850



GRC CUTS TINY BUSHING COST TO $2.00/M

Die cast by GRC in zinc alloy in a single automatic operation, this former screw machine part for a ball point pen, now costs little more than $2.00 per thousand in lots of a million. Each bushing is uniform, clean and accurate—no cut-off marks, no burrs, no secondary trimming and no scrap loss. Typical of the production economies and wide design latitude which GRC's exclusive patented methods have made possible on parts "no bigger than your thumbnail." (Maximum size is 1⅝" long, ½ oz.; no size too small).

Simple or complex, let GRC's unique techniques go to work for you . . . on tiny die cast *and plastic molded* parts made to order . . . on their wide variety of standard parts available in stock—wing and round head thumb nuts and screws, cap nuts, nylon screws, gears and pinions—you'll be glad you did.

Write, wire, phone TODAY for bulletins, spec sheets and prices. Send prints or specs for quotation.

GRIES

GRIES REPRODUCER CORP.
World's Foremost Producer of Small Die Castings
157 Beechwood Avenue, New Rochelle, N.Y. • NEw Rochelle 3-8600

For more information circle No. 120 on the Reader Service Card

Sintercast Corp. of America
134 Woodworth Ave.
Yonkers, N. Y.
(dies and tools, cemented carbides)

John E. Skach Tool Co.
1523 Mannheim Rd.
Stone Park, Ill.
(dies and tools)

Standard Machinery Div.
351 Indiana Ave., N.W.
Grand Rapids, Mich.
(mechanical and hydraulic presses)

F. J. Stokes Corp.
5500 Tabor Rd.
Philadelphia, Pa.
(mechanical and hydraulic presses, screening equipment, impregnation equipment, dies and tools)

Sturtevant Mill Co.
103 Clayton St.
Dorchester, Boston, Mass.
(mixing and blending equipment, screening equipment, laboratory control and inspection equipment)

Sun Chemical Corp.
Warwick Chemical Co. Div.
10th St. & 44th Ave.
Long Island City, N. Y.
(lubricants)

Sunbeam Corp.
Industrial Furnace Div.
4433 W. Ogden Ave.
Chicago, Ill.
(electric and fuel fired furnaces, gas generators)

Surface Combustion Corp.
2375 Dorr
Toledo, O.
(electric and fuel fired furnaces, gas generators)

Taunton Engineering Works
700 W. Water St.
Taunton, Mass.
(mixing and blending equipment, screening equipment)

Tungsten Alloy Mfg. Co., Inc.
65 Colden
Newark, N. J.
(dies and tools, cemented carbides)

W. S. Tyler Co., The
3615 Superior Ave.
Cleveland, O.
(screening equipment)

Union Wire Die Corp.
375 Fairfield Ave.
Stamford, Conn.
(dies and tools, cemented carbides)

Vanadium-Alloys Steel Co.
Latrobe, Pa.
(dies and tools, nickel, steel)

Vascaloy-Ramet Corp.
800 Market
Waukegan, Ill.
(dies and tools)

Welded Carbide Tool Co., Inc.
62 Colfax Ave.
Clifton, N. J.
(dies and tools, cemented carbides)

West Instrument Corp.
4363 W. Montrose Ave.

For more information circle No. 17 on the Reader Service Card

Believe it or not

AUTO-DIESEL PLUNGER RINGS *have lasted* **OVER 122 Days**

A short time ago most folks would have said that no ring could possibly last 122 days. But the facts are that Auto-Diesel Hardened Steel Plunger Rings have lasted OVER 122 days — they were immersed in molten zinc over 800 hours. IN MANY PLANTS THEY ARE GIVING OVER 100,000 SHOTS PER SET. (Names supplied upon request). They are made of cast iron, dieloy cast iron or hardened steel. It will pay to write for details.

AUTO-DIESEL 2 or 3 piece Plunger Segment Rings *Reduce* **DOWN-TIME**

It pays to reduce down-time. Auto-Diesel 2 or 3 Piece Plunger Segment Rings reduce down-time to the minimum. Made of high grade wear resisting iron in sizes from 1½" to 4" for hot chamber die casting machines.

Phone Our Representative Nearest You
Chicago Rep.—Vince Holstrom—Phone RO 1-2029
Detroit Rep.—Clifford-Rockwell Co.—Phone DI 1-5873
Cincinnati Rep.—Tarkington-Van Atten Co.—Phone PL 1-1434

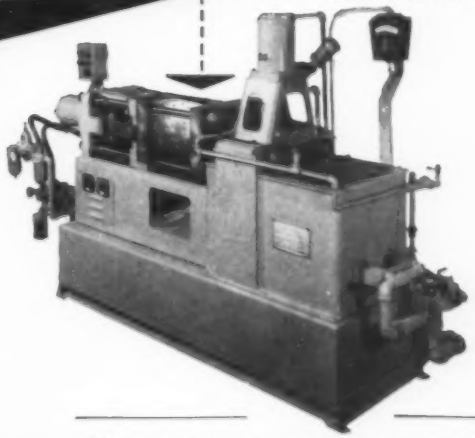
Write for Details

THE AUTO-DIESEL PISTON RING CO.
3135 Superior Avenue • Cleveland 14, Ohio **"RINGS and SHAPES Since 1921"**

Never Before- SO MANY FEATURES AT THIS LOW PRICE!

$4,967.00
f.o.b. Chicago

- NO EXTRAS
- NO ENGINEERING CHARGES
- SHIPPED COMPLETE —READY TO RUN



MODEL 60 — AIR AMERICAN DIE CASTING MACHINE

- 3 Lb. Shot Capacity
- 17¾" x 14½" Die Platens
- Over 1300 Free Cycles Per Hour
- Operating Cost 11¢ Per Hour For Gas and Electricity
- Financing Available Up To 36 Months

Many other features have been engineered into this machine including: 60 Ton Locking Pressure; Automatic Electric Cycling; Blast Furnace Type Blower. Let us send you full details. Wire—write.

These High Grade Components Standard
- NORTH AMERICAN Blower
- SQUARE D Electrical Controls
- ATC Timers
- NORGREN Regulator and Lubricator

AMERICAN DIE CASTING MACHINERY CO.
1760 W. WINONA STREET • CHICAGO 40, ILLINOIS

For more information circle No. 8 on the Reader Service Card

Chicago, Ill.
(pyrometers and pyrometric equipment)

Westinghouse Electric Corp.
Industrial Heating Div.
Market St.
Meadville, Pa.
(electric and fuel fired furnaces, gas generators)

Whittaker, Clark & Daniels, Inc.
260 W. Broadway Ave.
New York, N. Y.
(lubricants)

Winslow Co., Inc., The
701 Lehigh Ave.
Union, N. J.
(pyrometers and pyrometric equipment)

Witco Chemical Co.
122 E. 42
New York, N. Y.
(lubricants)

POWDER SUPPLIERS

Alan Wood Steel Co.
Conshohocken, Pa.
(iron)

Alloy Metal Powders, Inc.
238 Eagle
Brooklyn, N. Y.
(steel)

Aluminum Company of America
1501 Alcoa Bldg.
Pittsburgh, Pa.
(aluminum)

American Metal Climax, Inc.
61 Broadway Ave.
New York, N. Y.
(copper, tin, bronzes, silver and solder)

Belmont Smelting & Refining Works, Inc.
330 Belmont Ave.
Brooklyn, N. Y.
(copper, brass, zinc, aluminum, lead, tin, nickel, nickel silver)

Brush Beryllium Co., The
4301 Perkins Ave.
Cleveland, O.
(beryllium)

George Cohen Sons & Co. Ltd.
Wood Lane
London, England
(iron, steel)

Easton Metal Powder Co., Inc.
900 Line St.
Easton, Pa.
(iron)

Fansteel Metallurgical Corp.
2200 Sheridan Rd.
North Chicago, Ill.
(contact materials, tungsten, molybdenum, tantalum, columbium)

Federal-Mogul-Bower Bearings, Inc.
Detroit, Michigan
(bearings, copper)

Ferrum Limited
506 Ste-Madeleine Blvd.
Cap-de-la-Madeleine, Quebec, Canada
(iron)

Firth Sterling, Inc.
1330 Forbes St.
Pittsburgh, Pa.
(dies and tools, cemented carbides, other metal powders)

Foote Mineral Co.
18 W. Chelten Ave.
Philadelphia, Pa.
(iron, nickel)

General Aniline & Film Corp.
Antara Chemicals Div.
435 Hudson
New York, N. Y.
(magnetic materials, iron)

Glidden Co., The
Chemicals-Pigments-Metals Div.
1717 Summer
Hammond, Ind.
(copper, brass, lead, tin)

Greenback Industries, Inc.
2527 W. Maple Rd.
Birmingham, Mich.
(copper, brass, tin)

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
(iron, copper, brass, zinc, aluminum, lead, tin, nickel, nickel silver, steel)

Hoeganaes Sponge Iron Corp.
Riverton, N. J.
(iron, steel, custom blended powders)

International Nickel Co., The
67 Wall St.
New York, N. Y.
(carbonyl iron)

A. Johnson & Co., Inc.
21 West St.
New York, N. Y.
(mechanical presses, iron)

Kulite Tungsten Co.
1040 Hovt Ave.
Ridgefield, N. J.
(contact materials, nickel)

Magnetic Powders, Inc.
Fairview Ave.
Johnsonburg, Pa.
(iron)

Malone Metal Powders, Inc.
220 W. 42
New York, N. Y.
(copper, brass)

Metal Hydrides, Inc.
12-24 Congress
Beverly, Mass.
(70 Cr - 30 Ni, 50 Cr - 50 Ni, 30 Cr - 70 Ni)

Metal Powders Limited
73 Fifth Ave.
Iberville, Quebec, Canada
(iron, steel)

Metals Disintegrating Co., Inc.
P. O. Box 290
Elizabeth "B", N. J.
(brass, zinc, aluminum lead, tin, nickel, nickel silver)

Micronized Metals, Inc.
38-13 Tenth St.
Long Island City, N. Y.
(iron, nickel, steel)

National Moldite Co.
250 South St.
Newark, N. J.
(structural parts, cores, magnetic materials, iron)

National - U. S. Radiator Corp.
342 Madison Ave.
New York, N. Y.
(iron, nickel, iron-aluminum, iron-titanium)

New Jersey Zinc Co., The
160 Front
New York, N. Y.
(copper, brass, zinc, nickel silver, bronzes)

Powder Metals Research
6825 Adams
Gutenberg, N. J.
(contact materials; nickel, cobalt, tungsten carbide, tungsten alloy)

Pyron Corp.
Box E, LaSalle Station
Niagara Falls, N. Y.
(iron, nickel, steel)

Reade Mfg. Co., Inc.
P. O. Box F
Lakehurst, N. J.
(zinc, aluminum, tin, nickel silver)

Republic Steel Corp.
P. O. Box 338, Station "A"
Toledo, O.
(iron)

Reynolds Metals Co.
2500 S. Third
Louisville, Ky.
(aluminum)

Sherritt Gordon Mines Ltd.
Ft. Saskatchewan, Alta., Can.
(cobalt, cobalt-nickel)

Shieldalloy Corp.
Newfield, N. J.
(tantalum carbide, columbium carbide, tungsten-titanium carbide, titanium carbide, chromium carbide)

United International Research, Inc.
38-15 30th Street
Long Island City, N. Y.
(titanium, titanium alloy powders)

U. S. Bronze Powder Works, Inc.
Route 202
Flemington, N. J.
(copper, brass, aluminum)

Uniworld Research Corp. of America
1302 Ontario
Cleveland, O.
(steel)

Vanadium-Alloys Steel Co.
Latrobe, Pa.
(dies and tools, nickel, steel)

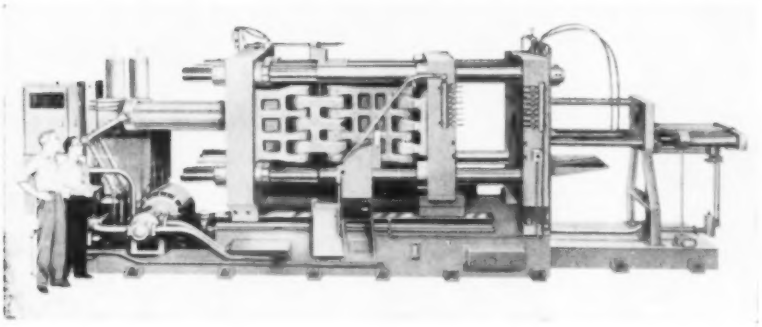
Whitaker Metals Corp.
1301 Burlington
N. Kansas City, Mo.
(copper)

C. K. Williams & Co.
2001 Lynch Ave.
E. St. Louis, Ill.
(iron)

NEW PRODUCTS AND DEVELOPMENTS

Want complete details on these announcements? Use the Reader Service Cards. You'll find them facing page 56 of this issue

HYDRAULIC DIE CASTING MACHINE HAS 1000 TONS LOCKING PRESSURE

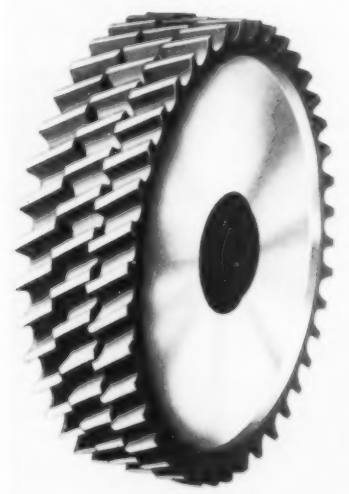


Built by Cleveland Automatic Machine Company, this die casting machine was designed for continuous rapid production of large aluminum die castings. The unit features extreme rigidity and guaranteed locking pressure of 1000 tons. A new cold chamber shot end, with intensifier, gives the flexibility in ram speed and final pressure to produce all types of castings. Shot plunger speed, after its initial slow, forward movement, can be adjusted to attain any speed up to 480 feet per minute. At any predetermined plunger position, the shot intensifier can be activated to generate plunger pressures up to 26,000 lbs. per sq. in.

Specifications are: size of die plates, 67″ x 67″; die thickness (max.—min.), 45″ - 24″; die opening, 20″ to 30″; space between tie bars, 42″ x 42″; floor space 113″ x 313″; overall height, 106″.

Circle No. 206 on Reader Service Card

RUBBER CONTACT WHEEL



Exceptionally deep serrations on the new R-58 contact wheel introduced by Chicago Rubber Co., Inc. enable it to shape itself to the contours of the object being ground and contact a greater area with each pass. Flexing of the belt when passing over the deep grooves shakes out dull abrasive and prevents the glazing that shortens belt life. In tests the wheel has increased the life of abrasive belts up to 200%.

Circle No. 205 on Reader Service Card

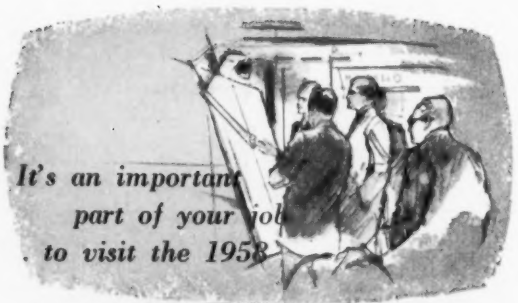
HOLDING FURNACE DESIGNED FOR FAST CASTING

New type GB furnaces are manufactured by Stroman Furnace and Engineering Company in four holding capacity sizes from 500 lbs. of aluminum to 2000 lbs. Exceptionally small size of the units allows close positioning to the casting machine. Resistance elements are located in a removable roof and can be replaced while the furnace is in operation. Power is supplied from a multiple-tap transformer which has a wide range of output, insuring good metal temperature control. Operation is on 220 volt or 440 volt, 3 phase, 60 cycle AC depending on the size.

Tests of the furnaces have shown a quiet bath with no turbulance, extremely low dross formation and low heat input requirement.

Circle No. 207 on Reader Service Card

EXCEPTIONALLY SMALL SIZE of this furnace allows it to be operated close to the machine doing the casting. Resistance units can be removed and replaced while the machine is in action.



DESIGN ENGINEERING SHOW

Concurrent A.S.M.E. Conference

Sponsored by the Machine Design Division, American Society of Mechanical Engineers, the 1958 Design Engineering Conference will be the most important event of the year in your field.

International Amphitheatre, Chicago

APRIL 14-17, 1958

New ideas are priceless. One new part, component or material can eliminate a bottleneck in your thinking, give you a completely fresh approach to a problem.

The 1958 DESIGN ENGINEERING SHOW teems with new ideas, new products, new services . . . the very latest developments from the top inventive minds of America. Engineers and technical experts from over 400 leading manufacturers will be on hand to go over your blueprints and job specifications with you, answer your questions, explain their new product applications, help you solve your product design and development problems.

For show tickets and information on Conference Registration, write:

Design Engineering Show
341 Madison Avenue New York 17, N. Y.

For more information circle No. 33 on the Reader Service Card

For more information circle No. 61 on the Reader Service Card

LepeL

HIGH FREQUENCY *Induction* HEATING

HARDENING
SOLDERING
ANNEALING
MELTING
BRAZING

LEPEL Electronic Tube
GENERATORS—1 KW; 2½ KW,
5 KW; 10 KW; 20 KW; 30 KW; 50 KW;
75 KW; 100 KW.
LEPEL Spark Gap Converters
2 KW; 4 KW; 7½ KW; 15 KW; 30 KW.

WRITE FOR THE NEW LEPEL CATALOG . . . 36 illustrated pages packed with valuable information.

All Lepel equipment is certified to comply with the requirements of the Federal Communications Commission.

LEPEL HIGH FREQUENCY LABORATORIES, INC.
55th STREET and 37th AVENUE, WOODSIDE 77, NEW YORK CITY, N. Y.

SELECT CENTURY FOR SPECIAL SHORT RUN DIE CASTINGS

DIE CENTURY CASTING CO.

MODERN EQUIPMENT TO MEET YOUR DIE CASTING NEEDS

SHORT RUNS
Small quantities made economically in both Zinc and Aluminum Alloys

UNIT DIES
For both Zinc and Aluminum Castings at a much lower die cost than conventional dies.
Unit Dies cover a wide range of casting sizes to fit your needs.

Consult Us on Your Requirements

CENTURY DIE CASTING CO.
2629 W. FLETCHER ST., CHICAGO 18, ILL.
TELEPHONE: IRving 8-2629

For more information circle No. 28 on the Reader Service Card

COMPONENTS

continued from page 35

used as a bearing material for a stainless steel shaft. No lubrication is required. None of the die cast parts are exposed so that no surface finishing at all is required, and there has not been a single case of corrosion encountered.

In this timer a small rocker arm is required. This rocker arm originally was fabricated from six separately machined parts, all of them low-carbon steel except the shaft, which was 416 steel.

In addition to the six parts, four assembly operations and three machining operations on the shaft were required. The rocker arm next was made as a single investment casting in aluminum bronze.

Very little machining was required on this part other than to turn the ends for fit into support holes and drill two small link holes.

With the older method of manufacture and assembly rated as 100% cost, the investment cast part in aluminum bronze represented a saving of 50%.

The final stage in the manufacture of this part has been to convert from an investment casting to a brass die casting. All of the required accuracy is present in the brass die cast part. It gives adequate wear resistance and impact strength, and has the very great advantage of costing only 30% as much as the original assembly.

NEW PRODUCTS— *continued*

REPEATING AIR HAMMER
. . . offers high versatility

Model 300-HH, a new air hammer built by Heidrich-Nourse Co., gives high or low force and speed, depending on the air pressure used, in trimming castings, impression stamping and other operations.

An auxiliary air traverse mechanism controlled by a foot valve, lowers the hammer cylinder to bring the impact tool down onto the work and hold it there during the work cycle. Internal valving actuated by the contact pressure causes the impact tool to repeat until the operator releases the foot pedal and the hammer cylinder is lifted from the work.

The tool is keyed against rotation and prevented from wandering by a precision fitted collet. A depth stop limits work progress.

Circle No. 145 on Reader Service Card

PORTABLE HAND GRINDER
. . . weighs only 13 ounces

Model No. 2 Moto-Tool is six inches long and weighs only 13 ounces. The unit does fast precision grinding, drilling, polishing, burring, etc. at 27,000 rpm. The short

body gives touch control on close tolerances. The tools are produced by Dremel Mfg. Co.

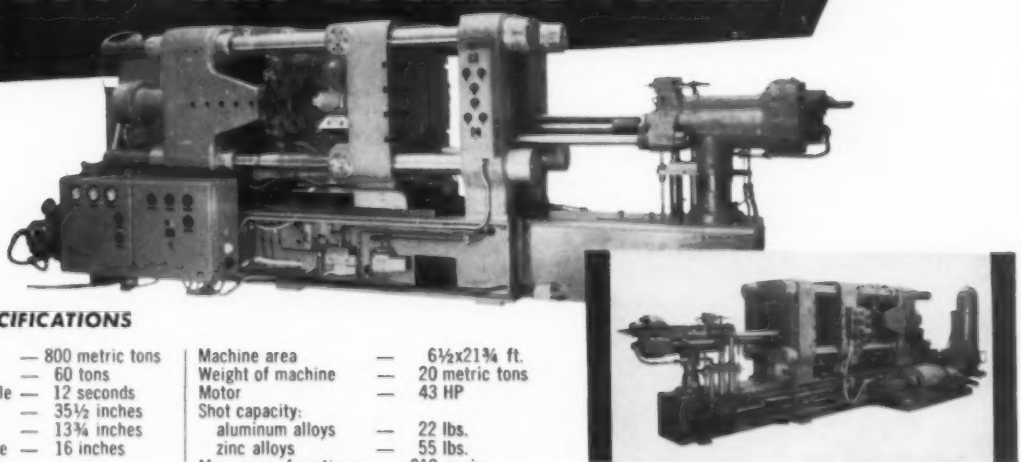
Circle No. 146 on Reader Service Card

Introducing the new

BUHLER DIE CASTING MACHINE

Type GPF

800 TONS LOCKING FORCE



SPECIFICATIONS

Locking force	— 800 metric tons	Machine area	— 6½x21¾ ft.
Injection force	— 60 tons	Weight of machine	— 20 metric tons
Time per free cycle	— 12 seconds	Motor	— 43 HP
Die height max.	— 35½ inches	Shot capacity:	
Die height min.	— 13¾ inches	aluminum alloys	— 22 lbs.
Die opening stroke	— 16 inches	zinc alloys	— 55 lbs.
Space between tie bars	— 28x30½ h/v in.	Max. area of castings with min. injection pressure	— 310 sq. in.
Size of die platens	— 45x47¼ h/v in.		— 5700 lbs./sq. in.

WRITE FOR COMPLETE INFORMATION

BUHLER BROTHERS, INC. (U.S.A.)
130 COOLIDGE AVENUE, ENGLEWOOD, NEW JERSEY

Engineers for Industry Since 1860

BUHLER BROTHERS (CANADA) **LTD.**
24 KING STREET WEST, TORONTO 1, ONTARIO

For more information circle No. 24 on the Reader Service Card

CONVEYOR UNIT . . . is portable and adjustable

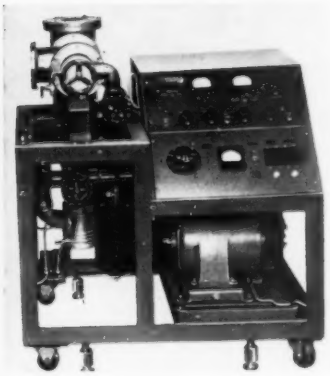
May-Fran Engineering, Inc. has announced production of the new "Heavy Duty Hustler" conveyor. A positive locking device permits up-and-down adjustment of working height, and conveyor pitch can be set for any angle up to 45° from the horizontal. Two wheels permit the unit to be rolled easily from job to job, but do not require floor-lock or blocks while in operation.

Because the equipment is adjustable and portable, its use in various types of industry can be expected by the manufacturers.

Another desirable feature is the variety of items available where needed for specific tasks in many areas of industry.

The conveyors are manufactured in various widths and lengths, with optional belt materials. Side guards and a parts-trap device for the loading end are optional equipment.

Circle No. 140 on Reader Service Card



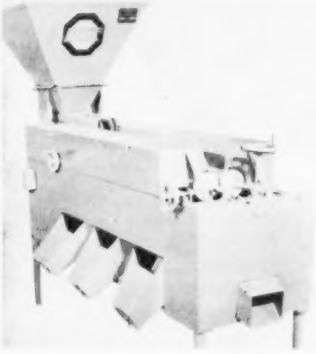
VACUUM PUMPING PACKAGE . . . is powerful & portable

A new packaged high vacuum pumping system capable of reaching pressures as low as 5×10^{-7} mm. Hg. has been announced by the Vacuum Equipment Div. of The New York Air Brake Co. The unit is compact and portable, and has applications in all kinds of research vacuum operations.

It is predicted for use in many newly opened fields.

The pumping system consists of a high-speed, fractionating Kinney #400F oil diffusion pump with a cold trap and a two-stage, gas-ballasted Kinney KC-5 mechanical vacuum pump. All meters and and switches are conveniently located on a sloping instrument panel, and all controls are at the front within easy reach of the operator. Modifications are offered for special purposes.

Circle No. 141 on Reader Service Card



DIMENSIONAL SEPARATOR . . . is accurate to .0025"

The ESBEC Dimensional Separator has been re-designed to give it greater accuracy, more flexibility and longer life. The machine, produced by Esbec Barrel Finishing Corp., makes difficult part separations which cannot be made by magnetic or shaker screen methods. Parts with smaller dimensions drop through an adjustable gap between two rollers, while larger parts are carried off the end of the rollers.

This separation of parts is a function which will help reduce handling costs. There are other obvious advantages which will benefit users of the equipment.

The new design includes three separate discharge chutes underneath the rolls and one at the end. Setting the gap between the rolls in a V-shape allows four separations to be made simultaneously.

Circle No. 142 on Reader Service Card

HYDRAULIC FLOW CONTROL VALVE . . . has multiple ranges

This new flow control valve for 2000 psi delivers constant set volume despite changes in temperature and viscosity, and has easily changed ranges of flow. To change the range, a fingertight locknut, control knob and pin are removed and an index plate turned until the desired range number lines up with the dowel pin hole in the body. Each selected range is covered by the full spread of the control dial.

The user has many ranges of control available to him.

The units are available in several two and three-port configurations for various circuit requirements, with optional check and relief valve set-ups. Port sizes are ¼", ⅜" and ¾", and flow ratings range from 5 cu. in. to 28 gpm. Units are manufactured by Denison Engineering Div., American Brake Shoe Co.

Circle No. 143 on Reader Service Card

You get speedier service from the

ZINC ZONE

Central location of American Zinc plants assures prompt deliveries of slab zinc to any point in the nation.

HILLSBORO, ILL., PLANT
Prime Western, Brass Special, Intermediate, High Grade, Continuous Galvanizing Grades
MONSANTO, ILL., ELECTROLYTIC PLANT
Special High Grade, High Grade, Continuous Galvanizing Grades, Special Shapes
FORT SMITH, ARK., SMELTER
Prime Western, Brass Special
DUMAS, TEXAS, SMELTER
Prime Western, Brass Special, Continuous Galvanizing Grades

PRODUCERS OF

ALL GRADES OF SLAB ZINC
ZINC ANODES (Plating & Galvanic)
METALLIC CADMIUM
SULPHURIC ACID
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ZINC CARBONATE
GERMANIUM DIOXIDE
AGRICULTURAL LIMESTONE
CRUSHED STONE

American Zinc Sales Company

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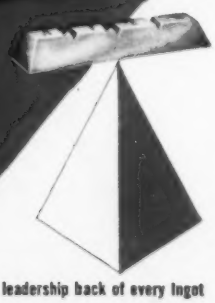

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